UNIVERSITY OF SOUTHAMPTON

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Archaeology

Roman Beirut: An Analysis of Economic Systems and Maritime Commercial Networks

by

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Abstract

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This thesis provides the first comprehensive assessment of *Berytus*, in modern-day Beirut, in its context as a Roman port city. It proposes a methodology for examining the economic infrastructure of the site that begins at a regional scale, and incorporates environmental and socio-political factors through multiple lines of data. This is done through the characterisation of the ecological landscape of the city and its hinterland, the productive capacity of rural settlements within this landscape, the urban centre and its harbour, and its prevalent maritime commercial networks. The focus in this work is on viticulture and oleiculture, specifically in breaking down the supply chain of products from an agricultural site to a final point of consumption. These factors are then contextualized under the theoretical approaches of network analysis and economic theory in an effort to place *Berytus* in the wider region, and compare site-specific trends with those observed throughout the Roman Empire.

This involves the critical examination of New Institutional Economics and its place in the study of economic history. Specifically, this thesis stresses the importance of a micro-economic, site-specific focus as a more effective way of understanding ports and port systems. An inductive approach moves away from the harmful dichotomy of 'market-centred' and 'socially-embedded', and prioritizes small-scale socio-political and environmental institutions as endogenous variables in economic models.

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Academic Thesis: Declaration of Authorship

Name: Naseem Raad

Roman Beirut: An Analysis of Economic Systems and Maritime Commercial Networks

I declare that this thesis and the work presented in it is my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission

Signed: Naseem Raad

Date: June 8, 2020

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Definitions

Commercial – Concerned or engaged with commerce involving identical or slightly differentiated products, typically pertaining to commonly-distributed and available products such as olive oil. To be contrasted with the term 'luxury', which implies expensive, highly differentiable products such as spices and jewelry.

Demand – The total quantity of goods or products a set of consumers wants and is able to purchase within a defined time frame and price schedule.

Distribution – The transportation of a set of goods or products from a source to a destination.

Distribution Balance – The difference between the total sum of imports and the total sum of exports between two sites.

Economic Rationale – A thought process that dictates the decision-making of an individual or institution, which attempts to maximise utility and minimise cost; assumed to be prevalent in most modern economic theories.

Endogenous – Inherent to and originating from within some entity. With regards to economics, it refers to a factor being included as an assumption within a model.

Exogenous – An external factor that is independent of a model, but might influence change based on a distinct set of parameters.

Extensive growth – An increase in total output due to an increase in the total quantity of inputs, maintaining the same function.

Good – A raw, unprocessed, tangible material.

Incentive – Something that encourages a person or institution to take a certain action. In economics, this is generally defined as monetary compensation, and assumes economic rationale.

Intensive Growth – An increase in total output due to a decrease in the total quantity of required inputs, also referred to as an increase in efficiency.

Loss – The difference between total revenue and total cost when negative.

Product – A refined and processed object, to be differentiated from a good. For example, a grape is a good while wine is a product.

Profit – The difference between total revenue and total cost when positive.

Rent – A sum paid, in cash or kind, by a lessee to a landlord in exchange for the rights to utilise some asset for a defined period of time based on previously agreed-upon criteria.

Supply – The total quantity of goods or products a producer wants and is able to produce within a defined time frame and price schedule.

Supply Chain – The process that describes all steps involved in the production and distribution of a good or product.

Surplus – The excess output remaining after self-sustenance. To be differentiated from the typical definition of an economic surplus, which is when supply exceeds demand.

Tax – A required payment, in cash or kind, made to the local or central government by an individual residing under the jurisdiction of the Republic or Empire. It is generally calculated based on a certain rate/percentage or on a fixed fee, and levied in different instances along the supply chain.

Trade – A kind of distribution that involves an exchange of one set of goods, products and/or services for another set deemed of equal value, or the monetary equivalent, by two or more involved parties.

Chapter 1 **Introduction**

Port cities have long been a central theme in the examination of ancient distribution networks and commercial developments, particularly in the Roman Republic and Empire (Frank 2004; Rostovtzeff 1926). Their presence is reflective of a number of intertwined ecological and socio-political processes involving an interconnected hinterland and maritime landscape. In this way, they provide a glimpse into economic webs by allowing a critical assessment of every link in the supply chain of a good or product from its processing site to the final point of consumption (Keay 2016: 291). This involves a wide array of topics, ranging from legal, administrative and financial infrastructure (Broekaert and Zuiderhoek 2020; Rathbone 2003; Verboven 2020), to harbour construction and accessibility by merchant ships (Blackman 1982a; 1982b; Boetto 2010; 2012; Oleson 1988; Marriner et al. 2010; Rickman 1988), to social relations and cultural diffusion (Rogers 2013; Verboven 2011). When contextualised within wider environmental patterns in the *longue durée* (Horden and Purcell 2000), port cities can provide crucial insight into the multi-faceted complexion of a society.

Such considerations are particularly important in the examination of the Roman Levant, given the lack of literature on the subject. The famous Phoenician port cities of Tyre, Sidon, Dor and Byblos are often referred to as early centres of trade, involved in intra-regional exchange with the coastal Levant, Cyprus, Anatolia, Greece and Africa, among a number of other areas (Markoe 2000: 21, 36). This characterisation is usually also applied to other time periods, creating a cohesive identity for much of the Levantine coast that is associated with mercantile prowess and a generally maritime-centred culture (Hall 2001-2002). However, the significant degree of regionalism in the Near East diminishes this perspective (Butcher 2003: 308). This is especially true for the Roman period, which saw a number of changes in administrative structure (Butcher 2003: 82-7; Sartre 2005: 54-87), in the demographic makeup of the region (Hosek 2012; Paturel 2019) and in religious practices (Newson 2019). The annexation of Syria and later Judaea into the Roman Empire also sparked a number of economic developments, especially at sites along the Levantine coast. This has been observed in the archaeological record in the urban expansion of port cities (Patrich 2011: 62; Perring et al. 2003: 199), as well as increased rural settlement in the hinterland (Butcher 2003: 79, 222; Sartre 2005: 90). Previously uninhabited, peripheral lands such as the Limestone Massif in northern Syria began to see the establishment of villages and small towns (Foss 1995). New port cities were established along the Mediterranean coast, while at existing sites, older harbour installations were refurbished, indicating a significant investment in the maintenance and upkeep of maritime hubs of distribution (Marriner et al. 2006; Raban 1989).

These developments reflect an active set of maritime networks involved in the intra-regional distribution of a variety of products (Butcher 2003: 132, 187).

One of these port cities, which had previously been overshadowed by its southern and northern neighbours, is the capital of modern-day Lebanon, Beirut. After the annexation of Syria to the Roman Empire in 64 BC, the city was made into the colony *Colonia Iulia Augusta Felix Berytus* sometime between 15-14 BC (Hall 2001-2002: 142-4). This marked a significant change in political status that differentiated the city from Tyre, Sidon and Byblos, also coming with impactful demographic, administrative and jurisdictional changes. The veterans of two legions were settled in the colony, coinciding with a territorial expansion in the city's hinterland (Abou Diwan and Doumit 2016; 2017). At least some portion of the land included within this territory was granted *ius italicum*, which made the tracts exempt from taxation (Arnaud 2001-2002: 181-2). Numerous temples and religious sanctuaries were erected in the mountains east of the city as well as in the Bekaa Valley (Newson 2019).

These patterns also coincide with economic developments within the urban centre as well as in the surrounding hinterland. These include the enlargement of the existing city limits, an increase in private and public construction in the city centre, the refurbishing of port installations and an expansion in territory (Elayi 2010: 160-1; Hall 2004: 95; Marriner 2009: 210; Millar 1993: 36; Perring et al. 2003: 204, 220; Seeden and Thorpe 1997: 236; Stuart 2002: 98-104, Fig. 5). This also applies to the capacity of production and distribution, as attested in the production of a new type of amphora utilised primarily to package wine (Reynolds 2000b; Woodworth 2011) and a rise in the frequency of wine and oil pressing installations in the colony's territory (Fischer-Genz 2016).

Beirut, therefore, provides a useful case study in shedding light on the structure of production and distribution networks in the Roman Levant. Though extensive typologies have been developed for the Beirut Type Amphora (Ala Eddine 2005; Reynolds 2000b; 2003; 2005), there remains a need for the quantitative analysis of its distribution throughout the Mediterranean. Furthermore, this also provides an opportunity to examine the often-mentioned maritime trade routes of the Roman Levant using statistical methods and network analysis. Though Beirut is often cited for its prowess in the trade of textiles, dyes or other luxury goods (Arnaud 2001-2002: 189; Hall 2001-2002: 152), these items rarely survive in the archaeological record. Given the definitive identification of an amphora type that came into production in the Roman period, and can be differentiated from other Levantine types, it is now possible to identify commercial patterns within which *Berytus* was involved with a consideration of regional and temporal scales. Most importantly, this allows for a comparison of all the aforementioned developments to Beirut's exporting capacity to help characterise the nature of these distributions and, ultimately, the economic nature of viticulture in the colony.

These inquiries are addressed in this thesis in a preliminary attempt to shed light on *Berytus* not just as a Roman city, but as a maritime centre and distribution hub for its wider, rural environs. To do so, it poses the following broad question:

- ❖ Which terrestrial and maritime commercial networks utilised *Berytus* as a distribution hub and consumption centre in the Roman period, and what do they reveal regarding the economy of the port city?

In pursuing this ambitious topic, I have narrowed the focus to the production and distribution of wine and, to a lesser extent, olive oil, and provided an in-depth characterisation of possible correlative factors with these patterns. This involves the posing of several sub-questions in exploring the economy of the port city based on viticulture and oleiculture:

- What is the ecological and geological character of Beirut and its environs?
    - What role might it have played in the distribution of rural settlements as well as production sites of wine and olive oil in the region?
    - What are the terrestrial and maritime routes it suggests based on climatic trends and topographic conditions?
- What maritime installations are visible in the archaeological record and how was the harbour maintained in the Roman period?
    - How do these developments relate to the urban centre, especially in the transition from a Hellenistic city to a Roman *colonia*?
    - How does the city compare to other port cities in the Roman Levant?
- What is the range and volume of the distribution of wine and, to a lesser extent olive oil, packaged in the Beirut Type along the Levantine coast and in Cyprus?
    - How do these patterns relate to urban developments at *Berytus*?
    - What are the commercial routes suggested by this data?
- What conclusions do these patterns suggest based on *Berytus*'s socio-political and environmental context?

In this way, this work provides a unique, comprehensive assessment of the Roman port and its commercial connections using published material, and interprets the data using economic theory and network analysis. Furthermore, it also represents the first attempt at a quantitative examination of the Beirut Type's distribution outside the urban centre. Given the common perception of Beirut as a centre of trade in the Roman period (Hall 2004: 21-44), it seems necessary to provide some definitive qualification for these propositions. The focus on products packaged in amphorae is useful in this regard, since they are found in vast quantities throughout the Mediterranean and were used to package commercial products (Keay and Williams 2014; Peacock and Williams 1986: 1; Peña 2007: 35).

This thesis starts with an overview of the history of research into port systems, network analysis and economic theory (Chapter 2). This is followed by a characterisation of the terrestrial and maritime environment of the Roman Levant, with a particular focus on Beirut and its surroundings (Chapter 3). I then detail my methodological approach in shedding light on the Roman port city and its economic connections (Chapter 4). Chapter 5 compiles the site-specific excavation reports of the Roman city to assess the port and its development through time. This is then compared to its environs, by outlining settlement patterns and the distribution of production sites of wine and oil in its hinterland and throughout Lebanon (Chapter 6). Chapter 7 and Chapter 8 are dedicated to tracing the Beirut Type's distribution in the eastern Mediterranean, and processing this data through statistical tests and network analytical tools, respectively. These various lines of data are then evaluated comprehensively within the socio-political, legal and administrative context of *Berytus*, and compared to macro-economic patterns suggested by Mediterranean-wide studies (Chapter 9). In this way, this work seeks to provide a site-specific economic characterisation through an inductive, multi-faceted approach before assuming cohesion with wider macro-economic trends. It proposes a methodology that might be better suited for outlining a broader range of causal factors in the growth or stagnation of ancient economies on a regional scale. It is through a compilation of these micro-networks that accurate and reliable conclusions emerge.

Chapter 2 **Relevant Literature: An Overview**

Given the large scope of this work, it is necessary to first discuss previous research that has explored the nature of maritime economics throughout the Mediterranean in the Roman period. This is of particular relevance for Beirut, given the lack of study of the city in its maritime context. This chapter serves to highlight the primary sources that have shaped the study of ancient economies, specifically with regards to the maritime and fluvial aspects of commerce. It is organised thematically, beginning first with the development of the study of Roman harbours throughout the Mediterranean (2.1), followed by the emergence of network analysis in better understanding the socio-political and environmental processes within which these sites were involved (2.2), and closing with the ways historians, archaeologists and economists have understood these networks through time (2.3). As this thesis revolves around the micro-market of Beirut and its relations with the surrounding region, there is a particular focus on the history of research in the Levant.

2.1 **Roman Ports and Harbours**

2.1.1 **A New Discipline**

As commercial exchanges of products packaged in amphorae in the Roman world largely took place through maritime transportation, archaeologists naturally turn to the hubs that facilitated the distribution of products throughout the Empire. Historians and economists studying the Roman Empire in the early-20th century examined ports purely in their economic context as part of a macro-study, discussing tariffs, fees, accessibility and size (Frank 2004: 103, 152, 158; Rostovtzeff 1926: 53, 151-2). Archaeological study of Roman and Hellenistic ports focused on physical descriptions of sites, environmental assessments and, to a limited extent, sedimentary analysis (Ardaillon 1896; Blackman 1982a: 85; Jondet 1916). This pattern was quite apparent in the eastern Mediterranean as well, where Antoine Poidebard undertook highly localised examinations of Tyre, Sidon, Beirut and Tripoli (Nordiguian and Salles 2000). He captured aerial photographs of the harbour sites and subsequently extended this research by bringing in divers to shed light on submerged archaeological structures. However, these early examinations did not prioritise archaeological methodology, especially since a number of these studies were not conducted by archaeologists. Fortunately, Poidebard's photographs are quite functional in nature, providing a clear view of major port cities in Lebanon from the early-20th century before many of them were looted and heavily disturbed. Thus, despite the fact that his subsequent analysis and inferences require refining (or in certain cases were disproven) (Frost 2005), the site-specific, descriptive approach taken at this time provides an invaluable resource for archaeologists re-examining the data.

In 1923, Karl Lehmann-Hartleben took a macro-view of maritime installations, characterising Mediterranean-wide patterns by publishing his compilation of ancient harbours based largely on literary evidence (Blackman 1982a: 86). His work marks a significant point in port and harbour studies in his consideration of inscriptions, texts and archaeological preservation, diverging from the site-specific, descriptive pattern. This essentially laid the base for future studies, but lacked detailed analysis of different lines of data and regional specialisation. Regardless, Lehmann-Hartleben's study remains to this day a key work on the physical morphology of Roman ports throughout the Mediterranean.

Over time, archaeologists in the mid-20th century began to shift back towards site-specific analysis of Hellenistic and Roman ports, but taking a more holistic methodology. This includes the work at the Claudian harbour in Portus, the Roman harbour at Leptis Magna, Massilia in Marseilles, Carthage and Sicily (Bartoccini 1958; Blackman 1982a: 88; Eadie and Humphrey 1978; Euzennat and Salviat 1968; Hurst 1975; 1976; 1977; 1979; Yorke and Little 1975). The nature of these explorations began to change, as publications detailed topographic maps (Euzennat 1976: 533, Fig. 2), displayed aerial photography to better understand the situation of the site (Yorke and Little 1975: 89, Fig. 3), detailed stratigraphic sequences (Euzennat 1976: 539, Fig. 10) and accounted for a changing coastline (Hurst and Stager 1978: 334; Raban 1980). These developments led to work embodying a multi-disciplinary approach, looking to incorporate multiple lines of data. This was also seen in the eastern Mediterranean, where Honor Frost had begun her work along the Levantine seaboard. She pioneered maritime archaeological work in the area, studying harbour works and proto-harbours mainly from the Bronze Age and Iron Age (Frost 1971; 1973; 1995; 1999). She catalogued anchors (1969), analysed the logging of timber (2000: 66-7) and dived most of the underwater sites in Lebanon, falling into a similar category as her colleagues with site-specific analysis utilising heterogeneous data.

However, there remained an issue of scope in placing a port within the wider context, both terrestrial and maritime. At this time, scholarship had focused on particular buildings or installations in the analysis of an ancient port, largely following the work of the first half of the 20th century (Rickman 1988: 257). As a result, most archaeological examinations of ports in the 1970's and 1980's either presented fieldwork results by detailing physical observations with limited wider comparisons, quantifying ceramic data, or qualitatively discussing the social and economic significance of the site (Oleson 1988: 147). This rift was problematic since ports 'occupy liminal positions between land and sea that can be appreciated only by looking at their relationships to surrounding hinterlands and to other ports' (Keay 2012: 33). Economists, historians, port archaeologists and the growing body of Roman ceramicists did not collaborate to produce holistic results that tied together commercial connections, social and cultural contexts and political developments in a comprehensive way. Scholars often acknowledged the importance of the port's place in the wider terrestrial and maritime landscapes, especially with regards to the functionality in serving as a distribution point for surrounding sites (Fulford 1980; 1983; 1987; 1989; Oleson 1988: 147; Will 1987: 171), but there was a lack of a clear methodology in better understanding these connections. Maritime archaeological work in Lebanon in the late-20th and early-21st centuries has also been almost exclusively site-specific, including work at Tell Fadous-Kfarabida (Pedersen 2007), Jiyeh (Waliszewski et al. 2006), and Tell Burak (Pedersen 2012). More extensive campaigns were undertaken at the northern harbour of Tyre, where a Phoenician jetty was recorded and excavated to a limited extent (Castellvi et al. 2007; Noureddine 2008; Castellvi 2012; Noureddine 2012), in addition to the underwater excavation of a heavily looted 6th-4th BC shipwreck near Tyre (Seco Alvarez and Noureddine 2010; Seco Alvarez 2012). However, similar to other earlier work throughout the Mediterranean, there is a definite need to contextualise results and incorporate multiple lines of data, especially given the promise of comparative approaches that provide regional characterisations (Blue 1995; Safadi 2018).

2.1.2 **Geomorphology**

In the 1990's, archaeologists working at Caesarea and Marseilles began to combine biology, geography, history and geology, marking the start of a multi-faceted approach in port studies and a standardised methodology (Hesnard 1994; Morhange et al. 1996; Reinhardt et al. 1994). One of the primary advances in this regard was the rise in the interest in geomorphological processes and their impact on coastal change (Blue 1995: 216-21), as well as the scientific study of biological, chemical and physical processes that effect change in topographic and bathymetric features of the earth (Flemming 1980), to shed light on socio-economic factors through the characterisation of a harbour's environment and natural affordances (Raban 1992). This allowed scholars to better understand sites in the *longue durée*, in addition to providing an invaluable methodological tool in rescue archaeology and large-scale urban excavations (Marriner et al. 2010: 22). Over time, this approach was sharpened into the methodology utilised today, combining a consideration of fauna, flora, sediments and geological processes to shed light on sea-level changes, coastal deformation and the characterisation of a harbour's degree of protection. Such studies were conducted quite frequently along the Levantine coast through the acquisition of sedimentary cores, geophysical survey and coastal survey (Carayon et al. 2011; Marriner and Morhange 2007; Rapp and Hill 1998). Geomorphologists working in the eastern Mediterranean also began observing patterns across the entire Near Eastern seaboard, developing regional geological markers that could be used for wider comparisons (Carayon 2008; Klein et al. 2004; Morhange et al. 2006).

Of particular importance is the incorporation of archaeological data from fieldwork in geomorphological studies to reconstruct coastlines and better understand sea level change (Brückner 1997; Carayon et al. 2011; Gifford et al. 1992; Pamir 2014). As opposed to simply providing closing remarks discussing the prevalence of other fields, experts were incorporating archaeological and geomorphological data in their analysis under a unified methodology. For example, at Beirut, geomorphologists outlined the changing coastline through a combination of sea level markers, sediment transportation, as well as artificial harbour installations (Carayon et al. 2011: 50). This is especially useful because of the difficult nature of the excavation of Beirut and the urban development that has largely truncated archaeological remains.

Geomorphologists since the early 2000's have also begun to standardise the markers that typify harbours through time (Goiran and Morhange 2001; Marriner et al. 2010: 24). An important example that geomorphologists often use is the characterisation of a harbour as one of 'low energy' or 'high energy', referring to the wave action and, subsequently, the movement and type of sediments within the examined space (Stewart and Morhange 2009: 394). The presence (or lack thereof) of certain fauna, as well as the size, shape and texture of sediments within the harbour, help shed light on the degree of protection afforded the harbour at various times (Reinhardt et al. 1994: 46). In other words, through the implementation of geomorphology in port studies, scholars were able to specify when a harbour was open and exposed (a high-energy environment), and when it was transformed into a sheltered space (a low-energy environment). Furthermore, sedimentary analysis also sheds light on upkeep and maintenance in harbours, especially in terms of dredging to keep the harbour from silting (Marriner and Morhange 2006; Salomon et al. 2016). These developments also marked an important change in archaeologists' approach to port and harbour studies in the development of a research method that could shed light on a site with poor archaeological preservation or severe coastal change. Moreover, certain maritime sites, such as Byblos in northern Lebanon, have not revealed any architectural remains of harbour installations. In these cases, geomorphological analysis can still specify the degree of natural protection afforded the site, and its suitability as a harbour through time (Carayon et al. 2011: 45-6).

2.1.3 **Port Systems**

The aforementioned approaches are especially useful in the translation of the accessibility of sites into a coherent network. Ultimately, the true potential of port and harbour archaeology lies not solely in site-specific analysis, but also in understanding the relationship between a port and the hinterland as well as other nearby harbours and ports that, together, form a port system (Chevallier 1968; Keay 2012: 33, 44; Rickman 1985; 1988: 1). Archaeologists and historians have been discussing this theme throughout the 20th and early-21st centuries, primarily with a macro focus to shed light on economic processes in the Empire as a whole (Arnaud 2005: 34-50; Gilissen 1974; Scheidel 2011). Parker's compilation of shipwrecks in the Mediterranean was a pinnacle work in shedding light on these routes as well as in comparing urban developments at specific port sites to wider commercial patterns (Parker 1992: 20-2). In this way, connections between ports could be assessed in terms of the types of cargoes being transported, the reciprocity of transactions and commercial capacity (Leidwanger et al. 2015; Wilson 2011b). Mediterranean-wide maritime courses were outlined, again revealing macro patterns (Scheidel 2013). However, regionalism is not often a prioritised factor in these discussions, and scholars often focused on large, extravagant ports characterised by various degrees of central administration and control (Wilson 2011b; Wilson et al. 2012).

An important development in this regard was the differentiation between types of ports according to size, function and nature as part of an increased focus on maritime landscapes (Blue 1995: Chapter 4; Flemming 1980). This had begun several decades prior to Parker's publication, with scholars distinguishing between types of ports such as 'escales', 'ports of call' and 'ports' proper (Chevalier 1967: 228; Gilissen 1974; Rougé 1978: 67-124). Regarding the Roman period, there was a recognition that not all ports were comparable to those of Alexandria or Rome, and there must be a consideration of smaller 'transit' sites that might have experienced significant traffic due to their position on specific routes (Flemming 1971: 27-33). These sites could range from a small, private port with some artificial installations and loading/unloading area (possibly associated with a villa) (Wilson et al. 2012: 379) to simply a naturally-sheltered beach or cove, described by Buti as *ports éphémères* (2010) and by Leidwanger as 'opportunistic ports' (2011). Furthermore, scholars had begun to recognise that seaside cities and towns, such as Byblos and possibly Ashkelon (Carayon et al. 2011; Galili and Sharvit 2000: 85), sometimes did not have artificial harbour installations, and but still may have handled a significant degree of maritime traffic.

Ultimately, these characterisations were largely made based on a site's capacity of imports and exports (Keay 2012: 56), functionality in loading and unloading ships (Casson 1965; Meiggs 1973,

Fig. 5; Rickman 1988: 263), physical harbour installations and administration (Hopkins 1980; Houston 1980; Mataix-Fernandez 2018). However, although early studies acknowledged the variability in Roman ports, harbours and anchorages, there remains a lack of consistent terminology and characterisation. Moreover, the application of these propositions on micro-regions did not formally occur until the 21st century, rising in tandem with network analysis in archaeology (2.2) (Leidwanger 2013d). The Portus Limen Project has been key in this development, presenting a standardised methodology in assessing various large Roman ports throughout the Mediterranean, and utilising a multi-disciplinary approach in placing each city within the wider maritime landscape. Most importantly, the project stresses methodological innovation and collaboration, as well as cross-site comparison in a field that has previously been characterised by isolated case studies (Keay 2019).

In addition to the maritime systems within which a port was involved, recent research has also stressed the importance of a port's place terrestrially, especially in its connection to rural sites in the hinterland (Keay 2012: 33; Keay and Paroli 2011; Uggeri 2006). Though archaeologists and historians in the past have noted the prevalence of a port's hinterland in supplying the urban centre with marketable goods and engaging commercially at the city (De Ligt 1990; Fulford 1983; Karmon 1985: 1; Leidwanger 2014: 7; Oleson 1988: 147; Rickman 1985: 105; Wilson et al. 2012: 384), researchers over the past several decades have stressed this point, and begun to formulate a methodological approach in characterising this relationship between port and hinterland (Evans 2018: 25; Keay 2012: 52).

This is also reflected in recent work in the Levant, where excavation reports are starting to include formal inquiries into the nature of the relationship between port and hinterland. At Caesarea, Patrich embodies a holistic approach, discussing inland routes to and from the port as intertwined with the maritime trade that the urban centre was involved in (Patrich 2011: 117-20). This consideration is more in-depth at other sites such as Ashkelon, where excavators formally include an assessment of the hinterland's role in the city's economy as three of the eight primary research goals, and propose hypotheses regarding the settlement pattern of rural sites in relation to the urban development of the port city in the Roman period (Stager et al. 2008: x). This was conducted through archaeological survey of the surrounding region, and differentiating between production sites of various agricultural products in the hinterland (mainly wine), regional collection centres for packaging, and the urban centre. In Lebanon, maritime archaeological fieldwork has been largely site specific, and a formal examination of the relationship between rural sites and urban centres at port cities such as Tyre, Sidon, Beirut and Byblos is still lacking. There have been some recent advances in this regard, specifically in identifying least-cost inland routes that connected the port of *Berytus* with its hinterland (Abou Diwan and Doumit 2017), and more specifically outlining territorial divisions (Paturel 2019). However, there remains a need for comprehensive analysis incorporating economic, environmental and spatial analysis.

2.2 Networks

In addressing these inquiries, archaeologists have begun using network analysis to visualise connections and create comparable models with quantifiable data. Network analysis tools are crucial in better understanding multi-faceted and complex port systems, especially in differentiating between various scales of focus. Most importantly, network analysis allows archaeologists to formalise and standardise these investigations, and provide different interpretations based on the chosen lines of data. However, despite the many benefits and opportunities afforded through the rise of network analysis, there has been inconsistency in the application of theoretical models. In this chapter, I give a chronological summary of development in the field and outline recent work in maritime archaeology to assess the level of uniformity in studies.

The study of networks originally emerged from graph theory, a branch of mathematics that dictated the visualisation and examination of general patterns and relationships (Barnes and Harary 1983; Brughmans 2010: 1-2; Harary 1969). These patterns can be represented using a graph, which denotes the structure of a web of connections. Over the course of several decades, network analysis emerged as a distinct field in that a network 'consists of a graph and additional information on the vertices or the lines of the graph' (Nooy et al. 2005: 6-7). Such a network is composed of vertices, or nodes, and lines between these vertices that signify their relationships (Brughmans 2010: 2).

As Brughmans outlines (2012: 624-5), disciplines as varied as physics, economics, biology, neuroscience and computer science all have implemented the research approach that network modelling proposes (Adamic and Huberman 2000a; Bascompte 2009; Newman 2010; Sporns 2002). This has resulted in different quantitative analyses being utilised within each field, specific terminology and definitions emerging among each field and diverse research traditions (Brughmans 2013: 624-5). Regardless, it must be recalled that at their core, these approaches retain the main concepts of network-based research: 'a focus on relationships between entities and on the patterns that emerge from them' (Brughmans 2013: 625).

2.2.1 Social Network Analysis (SNA): An Overview

The methods utilised by scholars of graph theory and network theory were also applied in sociology (Freeman 2004), though the roots of social network analysis can be sourced to the first half of the 20th century. SNA originally emerged from the field of sociometry, which focused on quantifying relations in small groups (Brughmans 2013: 632). Sociometry was founded by Jacob Moreno after the invention of the sociogram, a theoretical tool to represent the structure of relations within a group or groups in two-dimensional space (Moreno 1934, 1946, 1960; Moreno and Jennings 1938). Later scholars built on these early efforts and in recent decades, the principles of social network analysis were regularised and unified according to a specific set of principles (Wasserman and Faust 1994: 4). Specifically, Wasserman and Faust list four main points as being important in SNA:

- Actors and their actions are viewed as interdependent rather than independent, autonomous units
- Relational ties (linkages) between actors are channels for transfer or "flow" of resources (either material or nonmaterial)
- Network models focusing on individuals view the network structural environment as providing opportunities for, or constraints upon, individual action
- Network models conceptualise structure (social, economic, political, and so forth) as lasting patterns of relations among actors (Wasserman and Faust 1994: 4)

In recent times, these point have been updated to account for a greater focus on spatiality and the visual or graphical representation of results, as well as the necessity of computational approaches for data analysis (Bernard 2005: 377; Knappett 2011: 10; Terrell 2013: 19). SNA has been quite impactful on the development of network analysis in archaeology, though the archaeological adoption has resulted in heterogeneous methodologies and terminologies developed by a variety of different authors (Brughmans 2010: 2, 36; Graham 2006; 2009; Malkin 2003; Sindbaek 2007). However, before outlining the implementation of these principles in archaeology, it must be remembered that the SNA approach is unique in network-based methodologies in its focus on social entities (Brughmans 2013: 633; Newman and Park 2003: 1). As a result, SNA's 'applications are largely restricted to network visualisation and exploring the static structure of archaeological datasets or social hypotheses' (Brughmans 2013: 640). This causes difficulties in practice since archaeologists are separated from the social connections in the past they are attempting to reconstruct (Terrell 2013: 20), in addition to the fact that a strict focus on social processes cannot result in meaningful results. Such characterisations must be placed within a wider scope considering socio-political, archaeological and historical developments.

2.2.1.1 Centrality

One of the concepts developed by the SNA approach, centrality, relates to influence within a network. The idea was introduced by Bavelas in 1948, where he described the connection between structural centrality and influence in group processes (Freeman 1979: 215). Bavelas tested his theories in the mid-20th century (Smith 1950), and was able to conclude that centrality was, in some way, related to 'group efficiency in problem-solving, perception of leadership and the personal satisfaction of participants' (Freeman 1979: 215). Unfortunately, later studies were unable to hone in on more detailed results, and in terms of group problem solving, authors were unable to achieve consistent and cumulative results (Burgess 1968; Snadowsky 1972).

Regardless, this idea of centrality was expanded to assess social structures in general (Freeman 1979; Freeman et al. 1991; Friedkin 1991) as well as introduce different branches in the study of centrality in networks to account for multiple nodes within a network. This includes 'egocentric' designs that focus on the immediate locality of certain nodes, and suggest various ways of quantification and measuring (Faust 1997; Faust and Wasserman 1992; Freeman 1977; Marsden 2002: 407). In order to more reliably quantify the centrality of certain nodes in a network, scholars differentiated between the concepts of degree, betweenness and closeness (Brughmans 2010: 4-5; Freeman 1977; Isaksen 2008). Essentially, betweenness measures whether 'a point in a communication network is central to the extent that it falls on the shortest path between pairs of other points' (Freeman 1977: 35). Closeness has been defined as 'the ease with which a node can reach or be reached by any other node on the network' (Isaksen 2008: §13-§14), otherwise known as the level of 'independence of a point' (Freeman 1979: 224). The degree centrality measure has been identified to represent the sheer number of connections to/from a node (Radicchi et al. 2004: 2658). This measure does not necessarily imply high closeness or betweenness, but simply that one node has many links (Knappett 2011: 42).

These clarifications made the implementation of centrality in archaeological research quite attractive to help map out networks not solely according to spatial considerations (Knappett et al. 2008: 1009-10). Unsurprisingly, centrality measures are the most commonly utilised measures in archaeology in network analysis, particularly in transportation and distribution networks (Isaksen 2007, 2008; Jenkins 2001; Knappett et al. 2008; Mills et al. 2013). However, it must be recalled that current conceptualisations of centrality do not specify the strength of connections; rather, they largely assume connections to be equal, and quantify data based on the number of connections (Evans et al. 2009). This is an important clarification that will be discussed in more detail in Chapter 4.

2.2.2 **Complex Networks**

Another set of methodologies have been developed more recently, known collectively as the analysis of complex systems or complex networks. According to Mitchell, a complex system is 'a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behaviour, sophisticated information processing and adaptation via learning or evolution' (2009: 13). This approach acknowledges the often abstract and ambiguous links among a variety of nodes, and introduces the concepts of causality and correlation in these connections (Bentley and Maschner 2007: 245). These developments arose initially from the field of graph theory with the dissatisfaction in simplifying large-scale networks to being dictated by random graphs (Albert and Barabàsi 2002: 48). The response of scientists to this problem was to try and narrow in on specific definitions and some form of quantification and statistical analysis (Albert and Barabàsi 2002: 48). True to its definition, 'complexity' inspired formal analysis in a variety of subjects including philosophy (Cilliers 1998: 2) and physics (Albert and Barabàsi 2002; Barabàsi and Albert 1999), leading to the formation of models to try and predict collective behaviour within a system. This has translated into practical application to assess topics as diverse as the World Wide Web (Adamic and Huberman 2000; Huberman and Adamic 1999) and the brain (Siegelmann 2010; Telesford et al. 2011).

The methodology of complex system analysis has also been implemented in archaeology to improve and help formalise the quantification of data. While SNA applications have considered the issue of dynamism in networks, they largely centre around static networks (Brughmans 2013: 642). Complexity science, on the other hand, directly assumes adaptation and change (Brughmans 2013: 642; Mitchell 2009). Moreover, the models created by complex system analysis can incorporate the dimension of time (Brughmans et al. 2012), obviously a crucial aspect for archaeologists. As a result, several network models derived from complexity science have been utilised in archaeological analyses with interesting results. As it is outside the scope to discuss the full historical development of the subject, the next sections outline two of the most popular theories which are relevant in this thesis.

2.2.2.1 Small-World Networks

One of these theories is known as the 'small-world networks' theory. It was initially developed by Watts and Strogatz by utilising degree of clustering and path length as their variables, and obtaining different results by altering these values (Watts and Strogatz 1998). As the name suggests, the theory describes the concept of groups of nodes existing in clusters based on patterned homogeneity among themselves, with clusters subsequently being connected with different paths. Essentially, the model indicates that 'real-world networks are neither completely ordered nor completely random, but rather exhibit important properties of both' (Watts and Strogatz 1998). Thus, small-world networks will not follow either the 'regular' or fully 'random' networks, but rather, lie somewhere along this spectrum. The model has been further developed through specific definition of terms and formulaic representation (Albert and Barabàsi 2002; Newman 2010), and has been quite attractive in archaeology, probably due to its malleability as a theory. More specifically, in theory, small worlds can be created at any temporal or spatial scale. For example, a house could be considered a small world with the various rooms taken as nodes, and a network could be constructed by connecting it to other houses. Similarly, a town could be taken as a small world, with each house comprising a node, with the network being the connection of towns together.

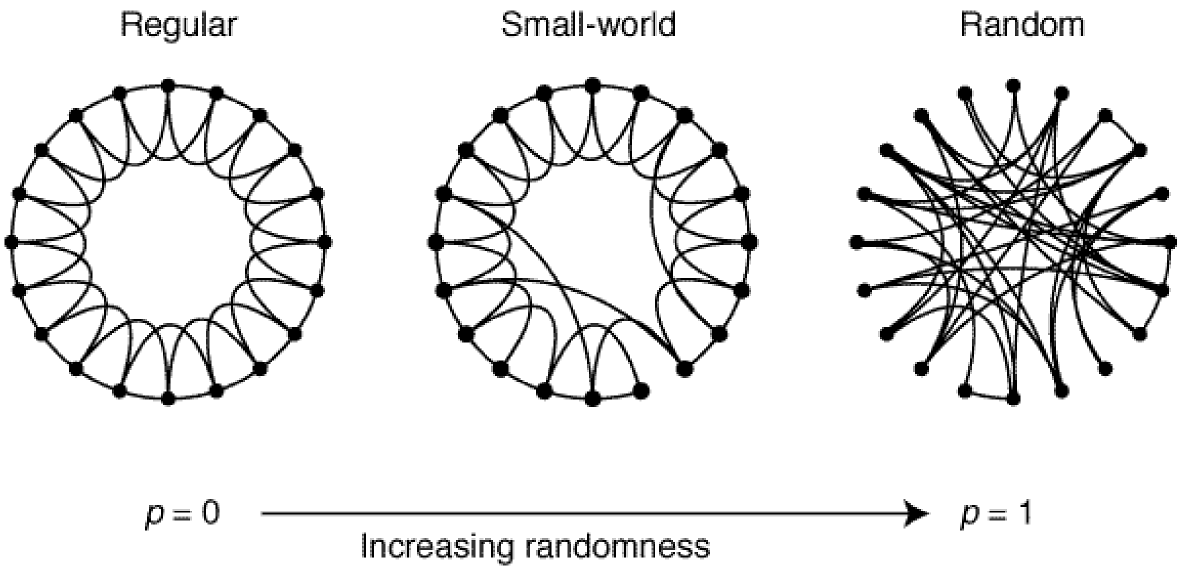

Figure 2.1: The emergence of a small-world network on the spectrum between completely regular or completely random networks (after Watts and Strogatz 1998: Fig. 1)

In archaeological analysis, such a system has helped in mapping out behaviour and tracing patterns across time and space. Bentley and Maschner suggest applying the small-worlds model to both prehistoric people as well as 'early state societies' (2003: 262). They explore the potential of recognising an individual's connections in Neolithic Europe. Such a person 'can exchange something (ideas, pottery, trade items) with virtually anyone in the network in just a few steps, by making use of connections at the appropriate spatial scale' (Bentley and Maschner 2003: 262). They state that one possible way of observing this in the archaeological record is through goods undoubtedly obtained through long-distance trade. They go on to apply the same analysis to the Indus valley in the transition between two phases, with the emergence of standardised production and long distance trade, and the later de-urbanisation of different centres, which also coincides with a heavy decline of interregional trade. They attribute this decline to the severing of the singular ties that connected each small world and the dissolution into a 'regular' network (Bentley and Maschner 2003: 262).

Another application of the small-worlds model can be seen in Graham's work observing connectivity and cohesion in different areas of the western Mediterranean. By placing different regions in the Mediterranean within a wider context, the small-worlds model is utilised to encompass the sea as a whole (Graham 2006: 58). Each port city belongs to its own cluster and each cluster is subsequently connected in some way across the Mediterranean; ultimately, individuals within each cluster can reach each other through these long distance connections, and certain individuals will be in advantageous positions to benefit from more connections (Graham 2006: 58-9). The model can also be utilised in a terrestrial context to characterise the small world of rural sites and their connection with a port. However, this requires a differentiation of types of nodes within the network. Such considerations have not been formally undertaken in archaeological analysis thus far, but certain studies have highlighted their potential (2.2.3).

2.2.2.2 Scale-Free Networks

Another system was proposed in 1999 that diverged from Watts and Strogatz' assumption that degree distribution is normal, suggesting that it is actually significantly skewed (Barabàsi and Albert 1999). Relationships are based upon a power law distribution, resulting in most nodes being less connected, with a lower percentage of nodes being very well connected (Albert and Barabàsi 2002; Brughmans 2013: 643). Already-established nodes attract new vertices, and nodes entering the network will attach preferentially to those well-connected nodes.

This approach has been criticised due to the underlying assumption that new individuals/nodes entering the network are at a severe disadvantage (Bentley and Maschner 2003: 643). According to the mathematical formula, the older agents dominate, while newer individuals enter with no hypothetical capital to warrant high connectivity. Furthermore, the larger a network becomes, the less clustered (Bentley and Maschner 2003: 644). This is not conducive to examining networks that display principles of both small-worlds as well as scale-free systems (Bentley and Maschner 2003: 644). These criticisms are well-warranted, but it must always be recalled that these networks were developed in the study of complexity, and are poor models to determine causality or differentiate between individuals' behaviour. Rather, they are representations of the sum of all behaviour within a given system. Therefore, historical and sociological context must be given to any scale-free network analysis, especially since the intervention of political institutions can often create imbalanced relationships on the regional scale. With regards to maritime archaeology, this is apparent in the construction of new, well-connected ports in previously undeveloped and poorly-sheltered areas, such as Caesarea in the southern Levant.

2.2.3 Application of Network Analysis in Maritime Archaeology

Clearly, the tools outlined in this chapter are quite effective in exploring networks between ports, hinterlands, smaller anchorages and shipwrecks. However, as observed in the multiple examples listed above, it is difficult to specify a standardised core set of principles that can be extrapolated for all case studies, especially in assessing a port system that considers a site's hinterland. Such research requires the incorporation of multiple lines of evidence at different scales of focus, as well as a consistent methodology in characterising a diverse set of terrestrial and maritime nodes.

Horden and Purcell's *The Corrupting Sea* is a significant work in regards to this multi-faceted approach in better understanding maritime connectivity (2000). It highlights the regional variations in the Mediterranean, stressing the importance of smaller networks and environments within the larger context (Horden and Purcell 2000: 123-72). The authors establish that connectivity within the Mediterranean is simply an aggregate of a number of relationships, with macro patterns emerging from countless micro interactions (Horden and Purcell 2000: 123). Most importantly, they advocate a different methodology in Mediterranean studies that focuses on connections as opposed to rigidly conceptualised routes (Horden and Purcell 2000: 172). Rather than organise the Mediterranean into distinct sections and explore macro-patterns between these regions, they emphasise a fluid, interconnected series of micro-environments and people. These connections are complex, detailed and are fragmented in nature (Horden and Purcell 2000: 53). Thus, the simplification of behavioural, environmental and ecological processes and connections into the term 'routes' is actually misleading and dangerous. It is more effective to explore each of these connections within the context of micro-worlds.

In this way, some of the concepts discussed in 2.2.1 and 2.2.2 can be useful in these explorations. For example, centrality is quite prevalent in understanding movement between ports and harbours. This is attested in Leidwanger's study of maritime routes in the eastern Mediterranean in the Roman period (Leidwanger 2013d; 2014). In Leidwanger's work, ports and ships constitute the nodes in the network, while distances between them constitute the links (Leidwanger 2014: 6). However, his discussion is not limited simply to geographical distances. This is due to the inherent connectivity between maritime networks in the region and the agricultural hinterland of Cyprus (Leidwanger 2014: 13). More specifically, 'smaller agricultural communities [are] interconnected across [Cyprus] and throughout this corner of the Mediterranean, laying the foundation for one type of regional economic market' (Leidwanger 2014: 13). In his work, Leidwanger highlights two important factors of network analysis: various scales of focus (2011: 4), and the different possible approaches in establishing connections (2013: 222). Regarding the former, Leidwanger differentiates between macro-scale, Mediterranean-wide movement of goods, and local, small-scale exchanges (2014: 2-3), preferring to focus on a micro-region to better understand maritime routes. More specifically, while the study of a Mediterranean-wide network would incorporate larger port sites such as Caesarea Maritima and Seleucia Pieria as nodes, a regional study would utilise ‘ports that were little more than coastal beaches where goods could be loaded and unloaded’ (Leidwanger 2014: 7). Subsequently, ‘rather than revealing a single integrated “trade network” in the Roman Mediterranean, this approach suggests multiple intersecting regional and inter-regional networks centred on distinct products, ships, agents, communities, and mechanisms’ (Leidwanger 2013d: 3-4; 2014: 15).

Figure 2.2: Map of a micro-region based on sailing time using Seleucia as a central node (after Leidwanger 2014: Fig. 4)

The concept of centrality, therefore, does not depend solely on geographical distance in practical application. Leidwanger’s work depicts one example of a measure for centrality: sailing time. In this way, the focus is taken away from space and utilises a measurement that implicitly considers a number of important factors (wind speed/directionality, currents, ship type/construction, accessibility of ports/harbours) (Leidwanger 2013c: 3303-6). More importantly, the measure is determined through the connection itself, as opposed to an assumption of connectivity and a focus on static routes (Leidwanger 2014). The study then allows us to compare different lines of evidence to maritime networks suggested by the natural environment to explore how closely the distribution of archaeological material matches the 'rational' routes for ancient seafarers.

In Keay's work (2010; 2012), a number of the principles discussed above are utilised to explore connections through a multi-scalar approach. As shown, the concept of 'betweenness' is prevalent in understanding how ports were connected. As Portus, the maritime port of Imperial Rome, developed and grew, ports and harbours that served as stopping points would have benefitted from increased traffic and greater market opportunity (Keay 2012: 52). Their level of betweenness from various destinations in the Mediterranean would have increased as traffic increased in Portus. Thus, in this case, the measure of centrality prioritises archaeological data, since the level of growth in Portus is determined by urban expansion and an increase in commerce at the port.

This expansion would have affected the surrounding hinterland, as each port could be seen as part of a small-world involving rural production centres, land routes, urban centres, and maritime facilities for packaging, storage, loading and unloading, etc. However, the small-worlds approach functions on a multi-scalar level. On one level, it is possible to view the port system itself as a small-world. This pertains to the connections between harbour facilities, specific harbour basins, quays and waterfronts, and the port city itself (Hurst 2010). Maintaining a small-worlds methodology, it is also possible to view the port system as a whole as part of a small-world. This differentiation is made by Keay regarding the ports serving Rome, where it is suggested that there existed a northern and a southern network of ports (2012: 54). Portus served as the main hub in both systems, but they are, in fact, separate networks. In this case, each network of ports could be seen as a small-world, and they are connected through Portus, which enhances its betweenness value.

As mentioned earlier, however, a port city's hinterland could be taken as a small world in itself, and related through various lines of data. While scholars often acknowledge the prevalence of this point (2.1.3), there remains a need for formal application. In other words, a terrestrial site with close ties to a port must be considered in assessing that port's relationship with other systems. This association of a terrestrial rural network with a wider port system is a critical step in shedding light on economic expansion, settlement patterns and a number of processes that are often seen as distinct.

2.3 Roman Economic Theory

In analysing the abovementioned networks and contextualising results, it is necessary to consider economic principles and political developments to better understand causality. Economic theory provides key insights in this regard, especially since the connections between ports are largely commercial in nature, and involve some transaction between two actors exchanging goods, services or money. Economics combines statistics, network analysis, sociology, game theory and countless other subjects to explain the processes that play such an impactful role in society.

However, applying the same logic to the ancient world is a great deal more difficult due to the assumptions of modern economic theory. Most notably, modern economics revolve largely around the concepts of economic rationale and the scarcity of resources, prioritising efficiency as the universal driving incentive for rational humans (Caballero and Soto-Oñate 2016: 332; Williamson 2000: 597). However, these assumptions are being challenged today, with various other paradigms emerging that propose different incentives (Maialeh 2019). Thus, given that recent research has indicated that comprehensive economic rationale is not necessarily inherently present in societies, and should not be taken as an assumption in economic models, it is inappropriate to apply these same, outdated theories to societies in the ancient world, so far removed from our own (Hobson 2014). For this reason, I here outline the rise and evolution of the study of ancient economies, with a particular focus on the Roman Empire to contextualise the methodological approach taken in this thesis.

2.3.1 **Early Development in the Field**

The ancient economy has been a matter of interest and debate for centuries, often characterised as an academic 'battlefield', where scholars claim fervent loyalty to one school of thought and vehemently reject the rest (Aarts 2005; Fülle 1997: 111; Hopkins 1983: ix). Each viewpoint purposefully or inadvertently draws from Classical economic principles, striving either to establish their prevalence or reject them as driving factors in ancient economic systems. These deep-seeded roots can be traced back to the late-18th century with Adam Smith's publication of *The Wealth of Nations*, where economics was arguably first established as a distinct scientific and mathematical field. Smith essentially laid the foundation for modern economic thought, formalising the concepts of labour, wage, rent, lending, interest, capital and other core variables in all economic considerations. In the study of ancient economies, historians, economists and archaeologists utilise these variables to shed light on the examined systems, which has led to a central theme: the prevalence of free-market principles or lack thereof.

This focus led to Rostovtzeff's impressive work, *The Social and Economic History of the Roman Empire* (1926), which made definitive statements about the nature of mercantile activity in the Roman Empire. Rostovtzeff, among others, insisted that commercial interests actually drove political decisions and military action, and production and distribution was dictated to some extent by economic rationale (Mommsen 1901; Rostovtzeff 1926: 21; 1957). These early works gave rise to the philosophical framework known as 'modernism', which proposes that the principles of competitive markets and economic integration were prevalent in the ancient world, with rational behaviour driving a sophisticated, well-connected system (Bang 2008: 29; Mommsen 1901: 167; Rostovtzeff 1926: 21). Based on such an approach, it is possible and quite useful to apply principles of modern economics to ancient systems. According to the theoretical approach of modernism, competitive markets within the Empire would have had comparable effects to those seen in capitalistic societies (Temin 2012: 13). Such an integrated market was able to develop in a politically-unified Mediterranean under the *Pax Romana*, which stabilised economic exchanges, stimulated trade, and allowed for regional specialisation (Temin 2012: 13). This system was supported by loans and insurance, provided by both private individuals as well as professional bankers (Andreau 1999: 43).

The opposition to this viewpoint essentially stated the opposite, minimising commercialism as the primary factor in the shaping and development of the Empire (Frank 2004). This debate culminated in Finley's influential book *The Ancient Economy* (1973), which established the school of thought known as 'primitivism'. Finley contrasted the modern economy with a much more controlled and socially-embedded ancient one that would be characterised in today's world as a developing economy (Finley 1973: 142). Based on this outlook, agriculture would have served only to supply local sites in most regions and industry would have been based on stagnant technology. In terms of distribution, primitivists claim that land transport was expensive and inefficient and sea-borne commerce would have involved luxury goods and government supplies instead of commercial goods to be sold to the mass market. Thus, trade would have only been conducted on a small scale, shipping would have been slow and sailing would have been impossible in Winter (Duncan-Jones 1974: 2). Financial management would have been fairly primitive since, according to primitivists, there was no credit system involved and banks were small-scale and isolated (Garnsey and Saller 2014: 43; Jones 1974: 23-30, 187). This had two major implications in the minds of primitivists. Firstly, this lack of economic rationale and self-awareness is reflected in the fact that people in antiquity never formally discussed economics as a subject (Hobson 2012: 11), further corroborated by the fact that many core economic terms that are utilised today did not exist in either Greek or Latin. Secondly, these propositions indicate that applying modern economic analyses to the ancient world was inappropriate (Aarts 2005: 4; Finley 1973: 17-34).

The strict adherence to one end of the spectrum or the other created a gap in theoretical discussions where the middle ground was lost. This divide grew beyond the characterisations of Finley and Rostovtzeff as scholars became polarised in the association of the ancient economy as either a stagnant entity that was not dictated by economic rationale, or a 'modern' system that was driven by the principles of incentive and efficiency, and periodically experienced depression, stagnancy, and per-capita growth (Saller 2002: 252; Silver 2007). This is curious as Rostovtzeff himself made clear that the situation is not black or white. He insisted that certain cities in the Roman Empire, such as Tyre and Sidon, were centres of commercial capitalism, while other areas 'lived under the forms of primitive house-economy' (1926: 538). Though the latter characterisation may be an over-generalisation, the consideration of a heterogeneous economic system is perfectly clear. Furthermore, Adam Smith also stated quite emphatically that there exists a clear distinction between ancient and modern economic systems, listing the Roman Empire as an example where the principle of economic rationale does not necessarily apply (1776: 299-316). Thus, ironically, the primary sources from which modernism developed are inconsistent with some of its core philosophies.

2.3.2 **Causation and Driving Forces**

Over the past 40 years, a plethora of archaeological evidence was uncovered that reflects regular distribution networks of a significant scope and scale starting in the late Republic. This data includes shipwrecks (Parker 1992), transport containers, primarily amphorae, used in the packaging of agricultural products for distribution (Keay 1984; 2010: 17; Panella 1982; Panella and Tchernia 2002; Peacock 1984), and vast agricultural tracts with associated pottery kilns in North Africa and Spain indicative of olive oil and wine production on an industrial scale (Mattingly 1988a; Mattingly 1988b; Remesal Rodríguez: 1998). As a result, maintaining a strict primitivist approach became untenable, and scholars of the Roman economy moved away from the dichotomy of modernism and primitivism to a more nuanced examination of the mechanisms that drove production and distribution within the Empire (Bowman and Wilson 2013: 21-5; Scheidel 2012: 9). In other words, given the sheer magnitude of data indicating large-scale distributions occurring over extended periods of time, scholars began to shed light on causative factors in this expansion as opposed to debating its very existence. However, early discussions still revolved heavily around the original debate of modernism and primitivism, with a number of branches emerging from the holistic terminology focused on arguing specific contentions in the long-standing discussion, such as substantivism, formalism, minimalism and maximalism. These terms are often used inter-changeably in modern studies, with significant overlap in the conceptual framework (Elliott 2020: 8; Saller 2002: 252-5). To avoid redundancy, I have summarised the main contentions often associated with each branch (Table 2.1), and focused on the most impactful works in the development of the study of the ancient economy.

Substantivism	***Formalism***	***Minimalism***	***Maximalism***
Branch of primitivism (often	Branch of modernism (often	Branch of primitivism (often	Branch of modernism (often

used synonymously)	used synonymously)	used synonymously)	used synonymously)
Social structure embedded in ancient economy	Insists that 'economic laws' are a part of human nature	Trade was insignificant in ancient economies	Trade was the primary driving factor in the Roman economy
Economic systems revolved around subsistence	Rationale and profit maximisation are inherent assumptions	Any distributions were functional in nature and dedicated to subsistence (army, *annona,* etc.)	Free-market trade dictated prices, routes, supply and demand
Not driven by economic growth	Incentivised by economic growth	Not driven by economic growth	Resulted in economic growth
Polanyi, Finley, Hopkins, Garnsey, Saller	*Silver, Temin*	*Duncan-Jones, Finley*	*Rostovtzeff, Durliat*

Table 2.1: Brief outline of sub-branches of modernism and primitivism, with associated scholars listed at the bottom (not exclusive or comprehensive)

2.3.2.1 The Evolution of Substantivism

Substantivism, in many ways, is simply another term used to describe primitivism. It was initially coined by Polanyi, and subsequently used inter-changeably with primitivism, with a specific focus on the fact that the Roman economy was a subsistence economy, prioritising fulfilling demand in urban centres and not expanding significantly beyond this threshold. However, a new wave of scholars had begun working on updating the static model of Finley and Polanyi to account for the aforementioned archaeological data. Despite the initial confinement within the shackles of the old debate, discussions were starting to prioritise archaeological material, moving from hypotheses based wholly on economic theory and historical context to quantifiable data. This arguably began with the works of Keith Hopkins (1980; 1983), who made the transition from a strict primitivist outlook that repudiated any possibility of large-scale distributions (Duncan-Jones 1974: 1-2) to one that proposed a socially and politically-embedded subsistence economy driven by tax-farming, tribute and rent (Hopkins 1980: 101-2, 104). Hopkins insisted that surplus agricultural products collected in provincial regions of the empire were controlled by an elite group as taxation, tribute or rent in kind (Hopkins 1980: 122). It is important to note that these developments do not necessarily indicate a paradigm shift, nor do they diverge completely from the propositions that the Roman economy was a socially-embedded system. Rather, Hopkins began to contextualise the mounting archaeological evidence, leading to various branches emerging from the umbrella of primitivism. The branch known as substantivism is different from pure primivitism in this prioritisation of subsistence in distributive patterns in the Roman Empire (Maucourant 1996: 133).

Hopkins's propositions must be clarified, as they were made to describe macro-economic processes across the Empire as a whole, and are problematic in site-specific analysis. Firstly, Hopkins correlates taxation with profit, and extrapolates this logic to all provinces in the Empire. The relationship proposed by Hopkins is linear, with low taxation resulting in higher profits, and higher taxation lowering profits (Hopkins 1980: 120-3). The only qualification he makes to this point is the fact that since local administration oversaw taxation systems, with the central government collecting a set quota each tax cycle, there was room for elite intermediaries to exploit the lower class by dictating tax rates (Hopkins 1980: 121). He goes on to specify that, as a result, discrepancies could arise between '(a) what peasants paid in tax and (b) what rich land-owners paid on similar land and between (c) what tax-collectors collected and (d) what they transmitted to the central government' (Hopkins 1980: 121).

In these qualifications, Hopkins diverges from the pure primitivist approach in his adoption of modern economic principles. Namely, the fiscal policy of the Roman Empire he suggests revolves around Keynesian economics, a macro-theoretical approach developed by John Maynard Keynes in the early-20th century which proposed various theories about how economic output is influenced by aggregate demand. The idea insists that four primary components dictate an economy's output of goods and services: consumption, investment, government purchases and net exports (Jahan et al. 2014). To stimulate demand, Keynesians insist on maintaining demand levels by incurring a deficit in public spending (either maintain tax levels and spend more, or cut taxes) (Lee et al. 2013: 83). The initial proposition revolved around the demand side of the equation, attributing the effects of tax cuts to the increased purchasing power of consumers, which in turn led to increased spending and subsequent extensive and intensive economic growth.

However, even in modern analyses, there is a significant degree of uncertainty and debate that revolves around the topic to this day (Mankiw 1993: 266). Thus, after incorporating the difficulties and complications of archaeological fieldwork and analysis, along with the interpretation of ancient texts and extrapolation of macro data, it is safe to say that the application of these models to the ancient world, or even the consideration of some of their principles is problematic. Returning to Hopkins's characterisation, his first point draws on the core concept that tax cuts, or low rates in general, result in increased profits. However, he does not differentiate between types of taxation, nor does he attribute the resulting growth to any specific factors. In other words, if we can indeed equate low taxes with high profit, which itself is a highly complex relationship, did low tax rates allow suppliers to increase production which sparked economic development? Or did demand rise because of the improvement in purchasing power?

Furthermore, Hopkins groups all forms of taxation (income, property, transit/tariff, census) under one umbrella term, and places the concept of rent on the other end of the spectrum: ‘the higher rents were, the lower taxes had to be’ (Hopkins 1980: 122). Obviously this is an over-simplification of complex economic considerations in the interest of formulating a macro-economic model. In this way, while the model is important in that it allowed scholars to pose new, relevant questions, it is not as effective in practical, archaeological analysis. Furthermore, it does not effectively differentiate between different types of growth (supply or demand, intensive or extensive, etc.). This requires a site-specific consideration, since cities in the Roman Empire fell under quite different jurisdiction based on recognised status, which affected taxation rates and political administration (Butcher 2003: 101, 103; Garnsey and Saller 2014: 32; Millar 1967: 82, 84).

This critical look is not meant to be dismissive, as Hopkins’s contribution to the field of Roman economics cannot be understated, ultimately catalysing the development of a number of other theoretical approaches over the next few decades. However, these approaches necessitate an overwhelmingly macro-oriented contextualisation of the Roman Empire, and do not account for regional analysis in various parts of the Mediterranean and beyond.

2.3.2.2 Formalism and Maximalism: Economic Rationale and Human Nature

In response to the modified model proposed by Hopkins, two branches of modernists universalised economic principles to apply to all humans throughout time (Silver 2007; Temin 2012). I avoid strict differentiation of the approaches, as there is significant cross-over between them and modernism as a whole. The sole point I wish to stress, and which arguably differentiates these approaches from their predecessors and successors, is that formalism and maximalism insist that economic laws are a part of human nature. As opposed to the theory that production and exchange in the Roman Empire was based on free-market trading, economists and historians such as Silver and Temin argue that the people themselves were motivated by profit, efficiency and economic growth, regardless of whether they were self-aware or recognised economics as a distinct social science (Silver 2007; 2008; 2009; Temin 2001; 2004; 2006). According to this view, there was no imposition of any structure that prioritised a *laissez-faire* policy; rather, such institutions arose naturally out of the inherent self-preservation of all humans, and manifested in political and economic structures as a natural process.

This leads us to the question of the chicken and the egg: do individuals create institutions and models (both real and abstract) which then direct development, or are these institutions simply reflections of agency within a society – natural, consequential results that arose organically (Nelson and Winter 1982; Sugden 1986; Williamson 2000)? Was it the state that drove economic development through the prioritisation of specific modes of exchange, or did the unification of the Mediterranean under the Roman Empire create an environment that indirectly created opportunities for a naturally profit-seeking population (Scheidel 2012: 9-10)? Did the changes in distribution patterns and productive capability develop organically, or did the state direct economic focus explicitly (Kehoe 2007: 6-8)? And if we can claim organic development, what was the driving force: land-owning elites, the central government, or the general public (Whittaker 1983; 1985)? These inquiries into human nature are most definitely outside the scope of this small review, but they are at the core of the current debate. While the answers are ephemeral and will differ depending on the examined pool of data, it is important to consider the implications of each side, especially since the inclusion of either viewpoint as an assumption greatly affects any deductive approach to Roman Economics.

2.3.3 **New Institutional Economics**

In answering these questions, scholars have recently turned to New Institutional Economics (NIE), which has provided a conducive theoretical approach in accounting for the 'otherness' of economic systems in the Roman Empire, and in many ways, consolidated modernism and primitivism (Kehoe 2007: 4). NIE was formally recognised as a unique economic perspective in 1975, with Williamson coining the term as a distinct field (Williamson 1975: 1-19). However, the ideas it proposed began percolating several decades earlier, primarily in the articles of Ronald Coase that suggested comparing institutions to better understand transaction costs (1937; 1960). He differentiated between 'external' and 'internal' costs (those inherent in economic models and those introduced through political institutions), and began to explore the ways in which these political and legal factors could be incorporated into economic models in a replicable and comparable way.

The concepts Coase explored were not new, as scholars had always considered political and legal systems in understanding nations in the modern world. The novelty was his background as an economist, and the formalisation of the factors as a part of economic models themselves. This approach was quickly adopted by other economists, most notably by Douglass North with several articles in the 1960's that continued developing the early roots of NIE on a broad, theoretical level (1965; 1969). Demsetz, another early NIE scholar, began to formalise Coase's propositions by incorporating legal and political systems as endogenous principles in economic competition (1973; 1982). In other words, rather than consider a country's economy and subsequently contextualise it within external legal and political structure, Demsetz suggested their inclusion as inherent parts of economic rationale. Cheung (1969), Aoki et al. (1981), and Williamson (1975; 2000) also hailed this approach as the new paradigm in economic thought, and, in collaboration with a number of other scholars at the time, began to incorporate a number of 'external' factors into economic models.

A primary set of definitions and criteria for NIE has been outlined by North over the past several decades. The core philosophy can be summed up with North's statement that 'institutions provide the incentive structure of an economy; as that structure evolves, it shapes the direction of economic change towards growth, stagnation, or decline' (1991: 97). Rather than separate economic processes from political and social institutions, NIE followers acknowledge they are intertwined and assess the system as a whole. The theoretical framework of NIE largely retains much of Neo-Classical economic theory, but introduces some variations: firstly, that the assumption of economic rationale is not inherent, and secondly, that the dimension of time must be considered to create dynamic macro-economic models (North 1996: 344). What this means in terms of economic analysis is that actors and organisations within the studied system are not expected to act according to perfect economic rationale (Bang 2008: 196). Followers of NIE promote an understanding of economies through institutions within each respective society that characterise much of economic development. Moreover, they suggest contextualising those institutions through what would normally be characterised as economic theory (Williamson 2000: 595, 601). Thus, NIE analyses 'processes in which institutions evolve' (Langlois 1986; Vromen 1995: 2). The imperfect and irrational interactions among individuals within a society ultimately result in the creation of institutions, as opposed to being 'predetermined in the "nature of things"' (Vromen 1995: 2-3). As a result, individuals do not act according to an inherent set of economic laws (as suggested by hard-line modernists), but rather, base their decisions on the 'rules of the game' dictated by the dominant set of institutions at a specific time and place.

Unsurprisingly, the main principles of NIE seem to have been tailor-made for the application to ancient economic systems (Elliott 2020: 11; Lo Cascio 2006: 218). After all, the primary question that had been the subject of debate among ancient economists for decades was whether the Roman economy was inherently different from the modern one, and if so, how to reliably model this. North himself identified this need for a consistent, comparable model in the application to economic history (1965: 87), as did other economists (Basu et al. 1987), even before the adoption of NIE by ancient historians and archaeologists themselves. Regardless, over time, modern scholars began to recognise the importance of 'the rules of the game', or the world in which the Roman economy developed. This arguably began with the formation of primitivism, and was further refined by Hopkins (1980; 1983), and later by Garnsey and Saller (1987). The former focused primarily on political institutions and the manifestation of these systems economically, while Garnsey and Saller leaned more towards the social-embeddedness of the Roman economy (Garnsey and Saller 2014: 133). Regardless, each of these approaches were inextricably intertwined with the inherent ‘otherness’ of the Roman Empire, and strove to explain economic patterns through a heterogeneous set of factors.

In the past several decades, studies have adopted NIE formally in the hope that an economic model which considers incentive structures other than pure economic rationale could find common ground between economists, historians and archaeologists on either side of the academic battlefield (Bang 2009: 206; Frier and Kehoe 2007; Maucourant 1996; Morris and Manning 2005: 34-5; Morris et al. 2007; Verboven 2020; Wilson and Bowman 2017). The suggestion was incorporated as a part of most scholars’ approach to ancient economics, culminating in Scheidel, Morris and Saller’s *The Cambridge Economic History of the Greco-Roman World* (2007). Various economic historians carved their own niche based on the new doctrine that assumed political and legal entities as inherent in economic models, and compared economies through history based on this assumption. Dennis Kehoe, for example, focuses on legal factors dictated by political institutions in the Roman Empire which affected economic choices and, in the long run, commercial patterns (Kehoe 2007: Chapter 1). Scheidel prioritises political institutions, namely the consolidation of the Mediterranean under one unified entity, as the driving factors of economic growth and expansion (Scheidel 2012). His view specifies the processes of ‘universal peace…predictable demand…and imperial stabilisation’ as driving forces in the expansion of distribution networks, higher rates of production and exchange, and more efficient techniques (Scheidel 2011: 36-7). According to Scheidel, technological innovation and efforts to improve nautical efficiency were less impactful in comparison to the establishment of peace throughout the Mediterranean, and were actually by-products of Roman unification (Scheidel 2011: 36). Scheidel claims these to be endogenous developments dependent wholly on the macro processes described above.

In this way, whether consciously or inadvertently, NIE followers address the following questions; do institutions effect economic change under static economic models, or does the introduction of social, political and cultural factors require the implementation of a new theoretical approach? In other words, do these institutions change the model itself, or do they effect change within the parameters of Classical and Keynesian economic theory? These questions introduce one of the primary problems of the current application of NIE to ancient economies. Theoretically, political and legal institutions are to be taken as endogenous to a holistic model; however, practically, authors continue to utilise the same macro-economic indices prevalent in Neo-Classical economics and Keynesian economics (Hobson 2012: 30-1; 2014: 11-14). Thus, although current deductive modelling of ancient economics entails a system which was directed and heavily influenced by political and legal institutions *endogenous* to the economic model, recent research has not successfully shown this practically. Terms such as per-capita GDP, per-capita productivity, per-capita economic growth and per-capita consumption are commonly used in these analyses (Jongman 2007b: 252; Morris et al. 2007: 5; Saller 2002: 258) to measure the effects of political and legal measures taken by the Roman government in effecting economic change. Lo Cascio, for example, stresses 'the importance of transaction costs and therefore of the role of institutions and of institutional change in determining the economic performance of a society' (Lo Cascio 2006: 218). Ancient economists applying NIE to their research continue to frame economic patterns within a static model that still prioritises economic rationale as an inherent goal of all individuals. In other words, they state that populations living in the Roman Empire acted in a way to maximise their utility in a system directed by government direction and administrative intervention (Verboven 2020).

Furthermore, as research has been largely dictated by historians and economists that tend to be fairly dismissive of archaeological evidence (Hopkins 2002: 196), or lean heavily on fragmentary data (Broekaert and Zuiderhoek 2020; Rathbone 2003), studies have primarily been macro-oriented. In certain cases, a deductive approach allows for meaningful analysis in situations in which it would have otherwise been impossible. This has been shown through the implementation of economic models to shed light on the movement of goods in the Roman Empire, incorporating sites lacking in systematic excavation or quantifiable data (Hopkins 1980). This approach also incorporates a number of different economic players in the production and distribution processes like the central government, land-owning elites and merchants (Rathbone 2003). These groups are unified by the stabilisation of the Mediterranean since they all functioned under the abovementioned conditions of peace, increased communication and better information across the Empire.

However, it must be recalled that patterns observed within the Roman Empire as a whole derive from exchanges, policies, and preferences across countless micro-regions (Horden and Purcell 2000: 123). The characterisation of the whole of these exchanges and relations under one unifying theory, though it may be effective in drawing similarities across the Mediterranean, cannot hope to account for regional trends or causative factors on the local scale (Leidwanger 2014). Furthermore, this theoretical structure also tends to diminish archaeological proxies as tools with which to characterise change over time and make meaningful, reliable statements about economic growth or recession (Scheidel 2009; 2012: 3-4, 11).

This approach has also been critiqued on a more fundamental level due to the underlying assumption that modern economic theory and principles can be applied to past cultures to produce results that are as viable as if one examined modern economies. Hobson asserts that such tactics fail to address complex social relations, and believes that contextualising specific situations is necessary to understand economic development (Hobson 2012: 37). He advocates a qualitative approach that accounts for the complexity and uniqueness of Roman North Africa, implicitly suggesting that a similar framework can be applied across the Empire. Quantifying economic indicators for the Roman Empire, in Hobson's view, is inherently problematic since these indicators were developed in the modern world to describe modern economies. Hobson has taken issue in the use of such indicators as being shaped by modern political ideologies (specifically those of Neo-Liberalism), and the circular logic associated with correlating human well-being with economic growth (2014: 21). For him, differentiating correlation from causation is problematic, especially in the abovementioned proxies. In this way, his propositions, self-admittedly, draw heavily from primitivist ideals that stress the inappropriateness of applying modern economic principles to the ancient world (Hobson 2014: 21).

However, it must be recalled that the abovementioned models are simply tools with which to examine ancient systems, and are not to be taken as objective. Proponents of the approach admit these limitations themselves and stress that the resulting estimates are actually 'determined by what we expect to have happened rather than by empirical measurements' (Scheidel 2010: 4). Furthermore, scholars studying the ancient economy often focus primarily on macro-patterns throughout the Mediterranean as one unified entity, overlooking the heterogeneity in *regional* institutions. While this results in cleaner, more satisfying answers, characterising the Roman Empire as the political institution that dictated economic patterns is not conducive to site-specific analysis.

2.4 **Conclusion**

In this section, I have outlined the history of research and highlighted gaps in the literature based on three broad themes: ancient ports and port systems, network analysis and Roman Economics. While this brief chapter is by no means comprehensive, two important divergences arise. The first is characterised by the lack of micro analyses in each field, which has left glaring gaps in the literature regarding the eastern Mediterranean. Scholars have previously leaned towards the regions of North Africa (Bonifay 2007; Bonifay and Tchernia 2012; Hobson 2012; Keay 1984; Mattingly 1988a; 1988b), Spain (Broekaert 2015; Remesal Rodríguez 1998; Reynolds 2010), Gaul (Christol 1982; Goudineau 1983; Rice 2016; Tchernia 1983) and Italy (Lo Cascio 2006; Scheidel 2010; Sirks 1991), especially in exploring economic patterns and port systems. This is partly due to the state of research, with a plethora of archaeological evidence and ancient texts being uncovered in the western Mediterranean and a dearth of data in the east. This is beginning to change with new studies emerging from Cyprus and the Levant that shed light on dynamic terrestrial and maritime networks and commercial routes traced by the distribution of amphorae

(Abou Diwan and Doumit 2016; 2017; Kaldeli 2013a; 2013b; Leidwanger 2013d; 2014; Wicenciak 2016a; 2016b). However, there remains a discrepancy, particularly in economic analysis, of micro-markets along the Levantine coast in the Roman period. Reynolds (2000a; 2000b; 2005) and Wicenciak (2016a; 2016b) have made great strides in detailing ceramic typologies and production sites, but these studies require formal contextualisation to shed light on the industries of wine and olive oil as a whole.

This brings up the second divergence, which is that there is a lack of interdisciplinary coordination. The exchange between Wilson and Scheidel (Scheidel 2009; Wilson 2009) and subsequent discussions – however limited – was promising in sparking greater communication between 'hard-line' archaeologists and historians that embody a more deductive approach. The benefits and opportunities of employing formal network analysis techniques in the analysis of ports, and subsequently extrapolating the data to begin to assess economic patterns grounded in a consistent methodology, are quite clear (Keay 2016: 292). Recent work has seen some significant developments in this regard, specifically in the Portus-Limen project, where scholars have embodied a multi-disciplinary approach to study Roman ports throughout the Mediterranean and assess their economic, political, and cultural significance (Keay 2020). By doing so, this work intertwines several fields that have remained esoteric for decades, asking appropriate economic questions grounded in formal archaeological inquiry (Keay 2016: 293). This thesis strives to adopt a similar approach on a micro level, and continue bridging the gap between these closely-intertwined academic fields. By doing so, I am proposing a methodology that prioritises micro-markets as effective scales to explore economic connections through an inductive approach.

Chapter 3 **The Environment of the Levant**

> *Wealthy people live around the gulf, and the location makes them rich, because the fertile district, perforated by navigable riverbeds, exchanges and combines, in a ready traffic, the diverse riches of sea and land.*
>
> - **Mela *De Chorographia* 1.68**

One aspect of this multi-disciplinary approach is a consideration of the ecological and geological characterisation of the study region. These factors help connect various sites that are often grouped into distinct categories, such as urban and rural, or central and periphery, through an independent line of data. As suggested by Mela in the above quote, the environmental context of a region largely shapes strategies implemented in settlement patterns, communication and agricultural production, among a number of other variables (Horden 2014: 38-40). This approach has been embodied recently by archaeologists striving to understand the geological evolution of a port site (Marriner et al. 2014) or to outline terrestrial routes when archaeological data is lacking (Abou Diwan and Doumit 2017). Thus, it seems useful and necessary to contextualise the data analysed in this thesis within the environmental framework of the region around Beirut and the Levantine coast as a whole.

In this thesis, I examine the terrestrial and maritime landscapes of the Levantine coastal region independently. The former serves to outline probable routes by land connecting Beirut with rural sites in the region, and specify the most suitable areas for the agriculture of grapes and olives (among other crops). The latter sheds light on maritime routes based on wind regimes, wave action and currents. These variables are subsequently considered together as part of an intertwined ecological system to lay the foundation for future chapters.

3.1 **The Land**

One of the crucial aspects that sheds light on wine and olive oil production in *Berytus* is the suitability of different regions in serving this commercial role. This helps to classify ideal lands for the cultivation of various crops, and narrow those regions down according to climatic conditions. This section outlines several environmental zones based on topography, soil type, precipitation levels, temperature and vegetation in order to differentiate between ideal, fair and non-ideal zones for the agriculture of various crops, primarily grapes and olives.

Figure 3.1: Map of the Levantine Coast depicting topographical features with prevalent sites and regions mentioned in the text

3.1.1 Physical characteristics of the Levantine coast

As the Levantine coast is predominantly westward facing and relatively unprotected from the frequently dominant south-westerly winds, features such as cliffs, capes, bays, promontories and offshore islands prove to be important sources of natural shelter to serve as anchorages. The formation of these topographic features involves four main processes: eustatic sea-level rise, tectonic activity, sediment deposition and climatic change (Blue 1995: 216). These factors result in alterations to the landscape that ultimately prove to be highly variable across regions, as seen in the differences observed in sea-level change, tectonic action and sediment movement between the northern and southern Levantine coastline (Galili, Zviely, Ronen et al. 2007; Morhange et al. 2006: 112-3; Pamir 2014 196; Pirazzoli et al. 1991; Shtienberg et al. 2014: 368). However, one important geological development that is consistent across most of the Levant is the series of 'kurkar' or 'ramleh' ridges that run parallel to the coast (Figure 3.2) (Marriner et al. 2014). Their formation is dictated by the accumulation of sediments along tracts of the Near Eastern seaboard (Mauz et al. 2013), and provide significant shelter from prevailing westerly winds and currents intermittently across various anchorages in the region (Blue 1995: Chapter 6). These offshore reefs sometimes result in the formation of small islands and islets, such as Arwad and Ras Ibn Hani in Syria. Over time, many of these islands became connected to the mainland and created conducive anchorages sheltered from the dominant south-westerly winds (Marriner et al. 2014).

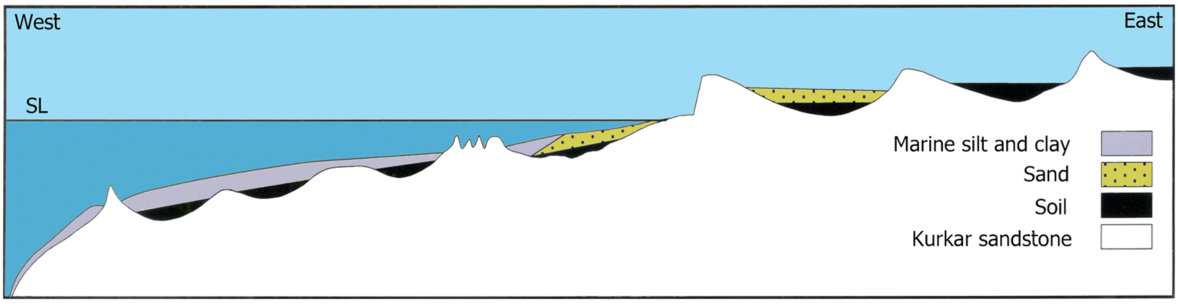

Figure 3.2: Cross-section of the kurkar or ramleh ridges that run parallel across much of the Levantine coast (after Galili and Zviely 2019: Fig. 3)

In the northern Levant, the main rocky projections from north to south are found at Ras el Bassit, Minet el Beida and Ras Ibn Hani, with a semi-protected bay at Latakkia (Figure 3.1). Highlands are close to shore, ranging between a distance of 3-20 km away from the coastline, and likely providing useful markers for ships approaching the coast. As fog is quite rare on the Levantine coast and visibility is generally good, prominent physical features would have served as useful navigational tools throughout the year (National Geo-Int Agency 2017: 46, 52). Between Latakkia and northern Lebanon, the area is characterised by a beach-rock shore (Sanlaville et al. 1997:

388). This stretch of coastline is directly westward facing without any significant headlands, and the bays of Latakkia and Minet el Beida provide the best natural shelter.

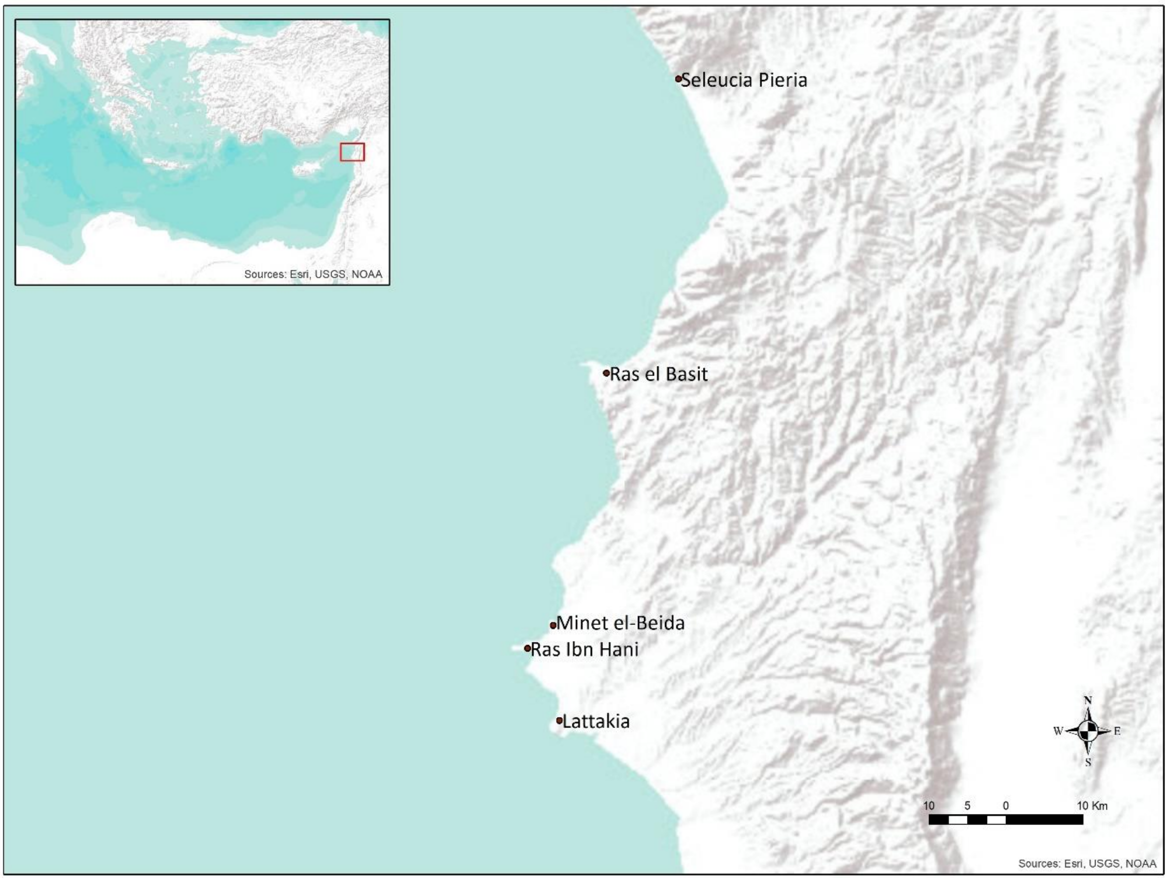

Figure 3.3: Coastline of the northern Levant

Roughly 150 km south of Latakkia lies the prominent headland of Tripoli in northern Lebanon, with protected bays on either side (Blue 1995: Chapter 6). The region south of Tripoli is composed of beach pebbles till Nahr el Awwali, with the northern extension being a sandy beach extending into Syria. Some protection from south-westerly winds is provided in the lee of Tripoli, but the region is hammered with cold north-easterly winds in Winter (Viret 1999-2000: 127). Several offshore islands lie roughly 5 km north-west of the rocky projection, the largest of which is known as Palm Island (Carayon 2008: 920).

Figure 3.4: The headland of Tripoli and its offshore islands

In the central Levant, the coastline is characterised by topographic slopes with sea cliffs and wave-washed platforms, and is fairly exposed to the dominant winds (Beydoun 1976: 320-1). The main bays are found at Byblos and Jounieh, and provide a significant degree of natural protection (Safadi 2016: 358). Three main projections provide shelter at Beirut, Sidon and Tyre. Beirut is situated on a rocky headland, with its western face being exposed to the prevailing winds and swell. The western face is characterised by tall sea cliffs in the north and low, sandy beaches in the south till modern-day Khalde (Carayon 2008: 267-8). Along the northern face of Beirut, several small bays can be found which are sheltered from the dominant south-westerly winds.

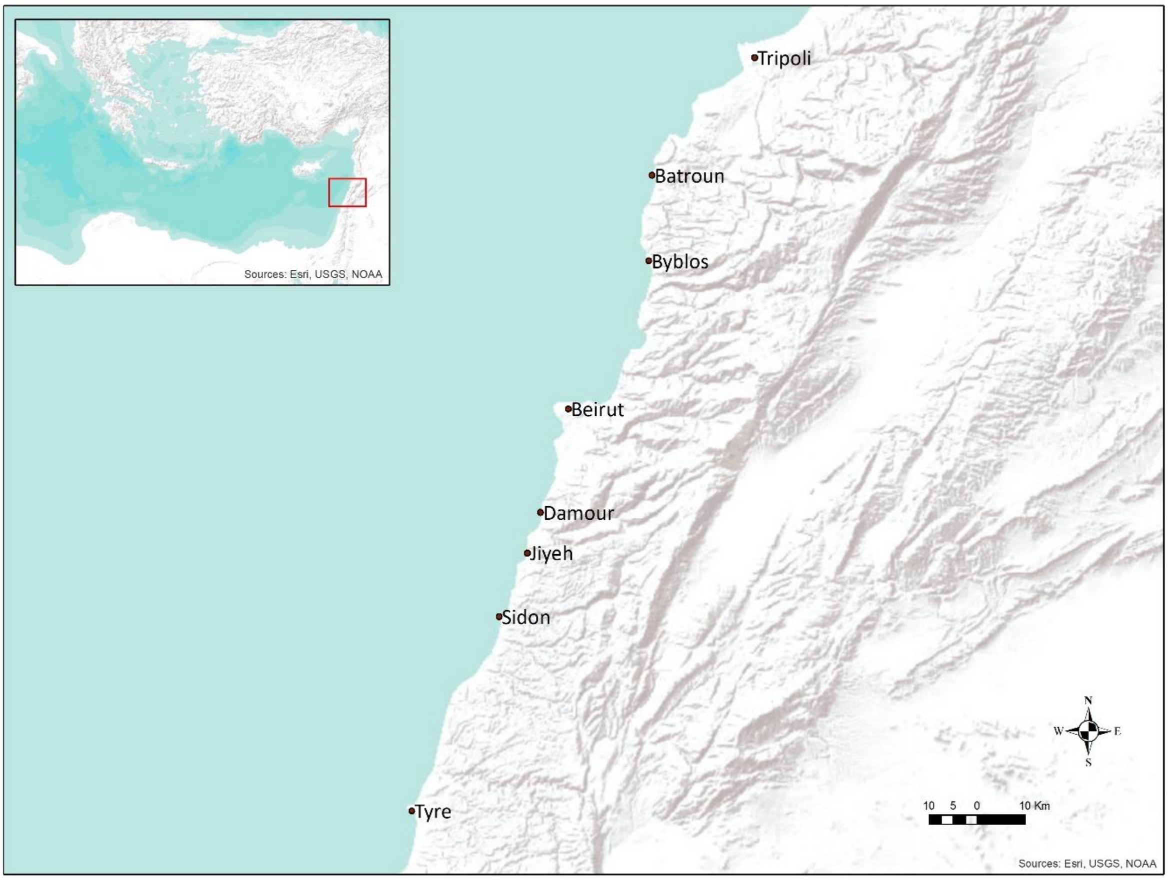

Figure 3.5: Coastline of the central Levant

Figure 3.6: The rocky headland of Beirut in the central Levant

The next main projection in the central Levant is found at Sidon. It is flanked by Nahr el Awwali in the north and the Litani River to the south, and lies on a low S/SW-N/NE promontory with several promontories separating sand beaches (Carayon et al. 2011: 434). Two main harbours are formed by a rocky ridge, one south of the city's projection and one north. The island of Zireh, located just offshore the mainland of Sidon, affords significant shelter from winds and swell (Morhange et al. 2011). This area is characterised by low, continuous sandy extensions, with the only rocky portion of the coast being at the foot of capes and that of Jabal Terbol (Beydoun 1976: 320; Sanlaville 1977: 9). Roughly 40km south lies the city of Tyre, originally an offshore island before being joined to the mainland in Alexander the Great's notorious siege (Pliny *HN* 5.17). Similar to Sidon, the site is characterised by two main harbours north and south of the city separated by the constructed landmass on which the modern city lies (Carayon et al. 2011: 46-9).

Figure 3.7: The site of Sidon and offshore island of Zireh

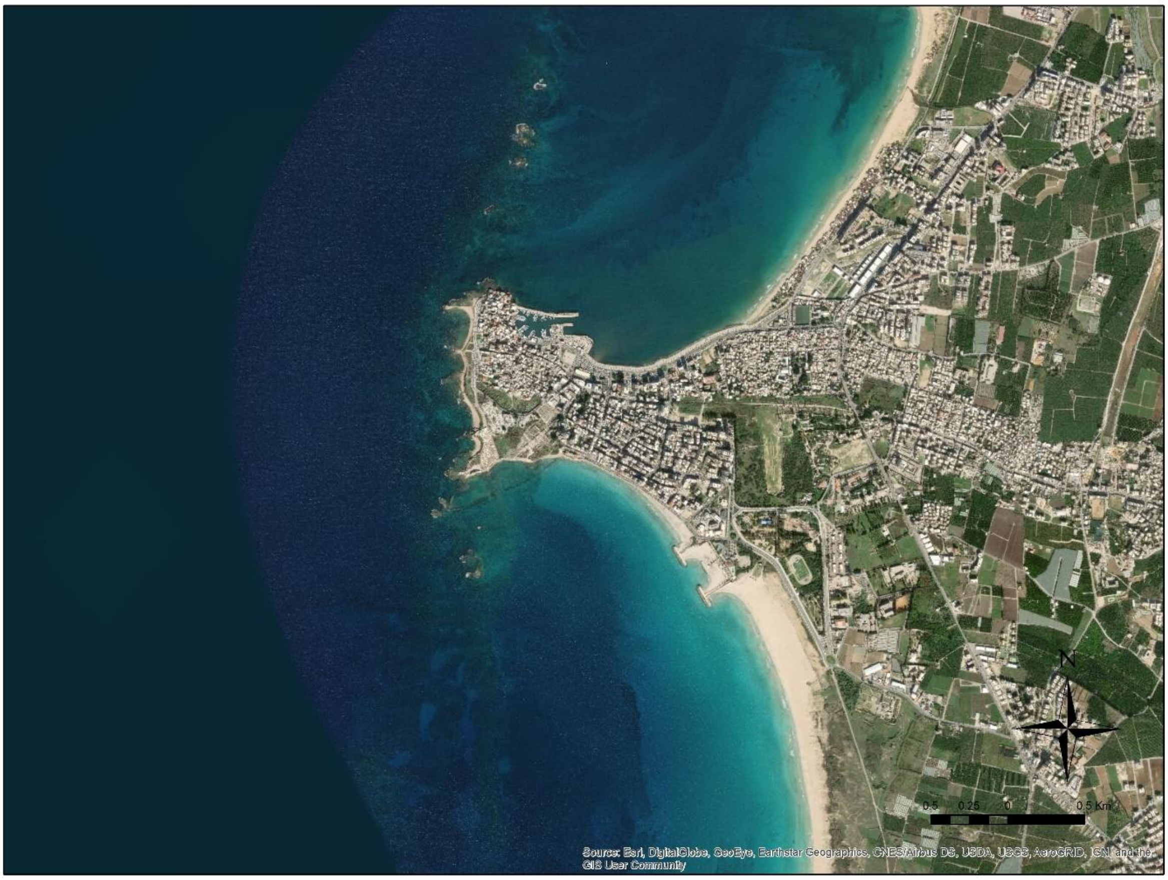

Figure 3.8: The headland of Tyre

In the southern Levant, kurkar ridges are more prominent and defined at various sites (Raban and Galili 1985: 321), particularly around the Sharon Plain, where they reach heights of 50m (Neev et al. 1976: 2). As observed in parts of Syria, these ridges can form offshore islands, such as those observed at Rosh Haniqra (Blue 1995: Chapter 4). The other geological process which is especially influential is the deposition of sand and silt from the Nile Delta, which results in intense sedimentation along the coast (Stewart and Morhange 2009: 386). For this reason, among other complex geological interactions, topographic features that provide shelter from sedimentation, currents and dominant winds are less frequent.

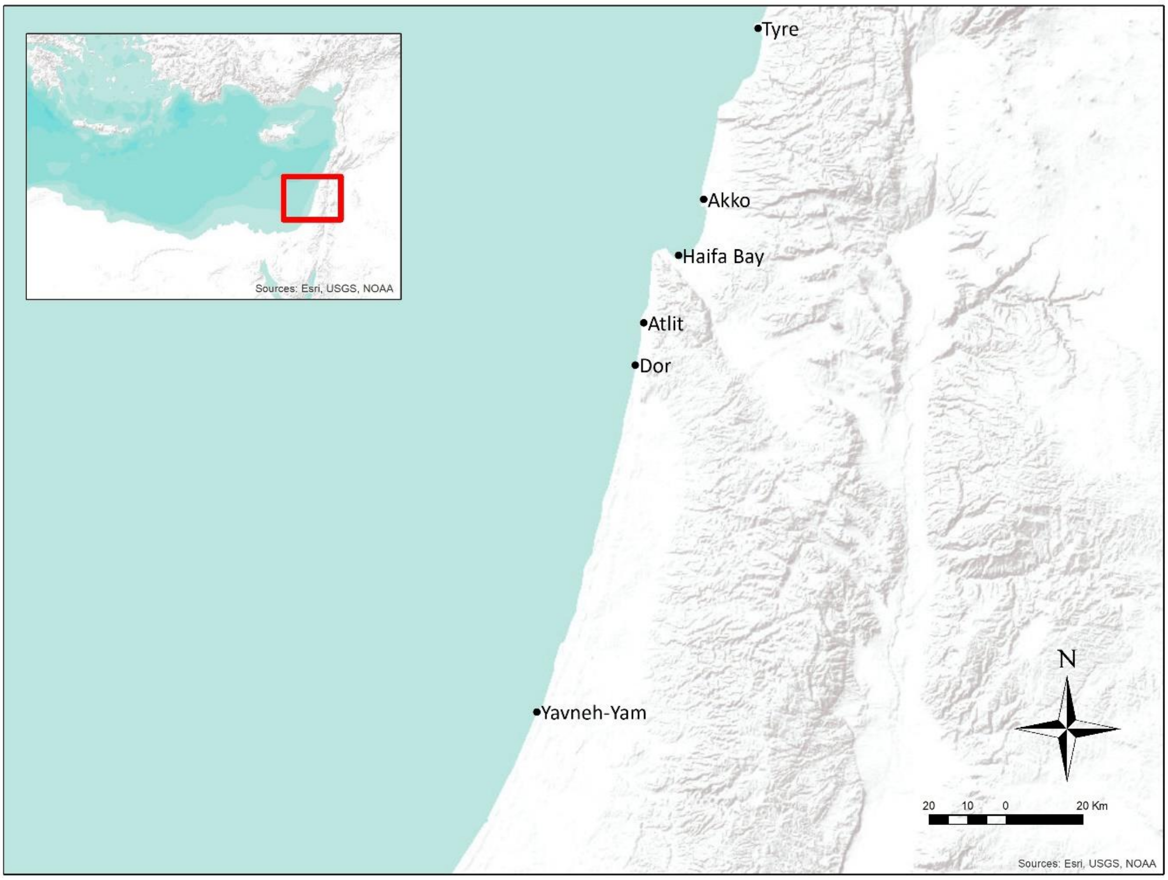

Figure 3.9: Coastline of the southern Levant

Near Rosh Haniqra, Akko represents the northern-most projection along the southern Levantine coast, affording some limited shelter in its lee (Blue 1995: Chapter 6). It lies just north of Haifa Bay, the most pronounced bay in the southern Levant. Haifa Bay is located near the north-eastern limit of the Nile littoral cell and represents the final depositional basin for Nile-derived quartz sand (Zviely et al. 2006: 849). The coast is largely bordered by cliffs, and lined with a row of four submerged ridges that run parallel to the shore, providing shelter in their lee to the inner portion of the bay (Stewart and Morhange 2009: 389; Zviely et al. 2006: 851). Protection is also afforded by the promontory of Haifa, which is an extension of Mount Carmel and bounds Haifa Bay to the south (Raban 1983: 216).

Figure 3.10: Haifa Bay in the southern Levant, partially sheltered by the promontory of Haifa

Roughly 15km south of Haifa lies the rocky, anvil-shaped promontory of Atlit, which provides two anchorages on either side of it. Dor lies an equal distance south of Atlit, representing another narrow beach formed by a slight indentation in the kurkar ridge running along this area (Blue 1995: Chapter 4). South of Atlit, the central part of the coast, as mentioned earlier, is characterised by high kurkar cliffs and narrow beaches, such as that observed at Jaffa (Neev et al. 1976: 2). South of this region, the coast becomes entirely flat and sandy, with only two small areas where cliffs border the sea (Blue 1995: Chapter 4; Schattner 1967: 310). The sands in this region, unlike the northern part of the coastline, can be sourced to the Nile and its delta, which are deposited in the Mediterranean Sea and carried north-east in currents (Stewart and Morhange 2009).

3.1.2 **Topography of Roman Syria and *Judaea/Syria Palaestina***

In terms of its terrestrial characteristics, the coastal Levant is characterised by a long, narrow coastal strip sandwiched between the Mediterranean Sea and various mountain ranges from south to north. The northern range, known as the Syrian Coastal Mountain Range, runs N-S through north-western Syria, ending near Ras el Bassit to open into the Homs Gap (Beydoun 1977: 320). It lies fairly close to the coast, generally varying between 3-5 km, with wider coastal plains located near Latakkia and Tartus. East of this range, the majority of the central region is arid, dry and flat, with slightly higher levels of precipitation in the northern region at the Limestone Massif, a rocky plateau in northern Syria. There is a lowland gap between the Syrian Coastal Mountain Range and the Anti-Lebanon Mountains known as the Homs Gap. This corridor leads to the Lebanese city of Tripoli further south and represents the northern-most crossing through the coastal highlands of the Levant from Syria to Lebanon.

In Lebanon, the width of the coastal strip varies between 1.5 and 6.5 km, running NNE-SSW parallel to the highlands. Particularly wide coastal plains are observed near Tyre, Beirut and Tripoli, where either rocky headlands or sediment transportation increase the surface area of the coastal plain between the Mediterranean and the Mount Lebanon Range. The adjacent Mount Lebanon Range runs the length of the country, eventually meeting the Anti-Lebanon Mountains further south near Mount Hermon. The elevation of the range varies between 500 and 3093m, with the highest peak at Qornet as Sawda near El Arez in northern Lebanon (Yazbek et al. 2010). The range decreases in elevation further south, especially near Tyre where the hinterland is composed of an extension of hills. East of the Mount Lebanon Range is the Bekaa Valley, a lush and fertile area that has served as an agricultural centre for the region for millennia (Yazigi et al. 2014: 66). It lies beneath the Anti-Lebanon Mountains, which represent the border of the modern-day countries of Lebanon and Syria. The Bekaa Valley lies roughly at an average of 1000m, and is characterised by varied agricultural zones that can be differentiated based on elevation, soil composition and precipitation. East of this range, the land is dry and generally flat, with sporadic, rocky highlands highlighted in more detail in Figure 3.11 and Figure 3.12.

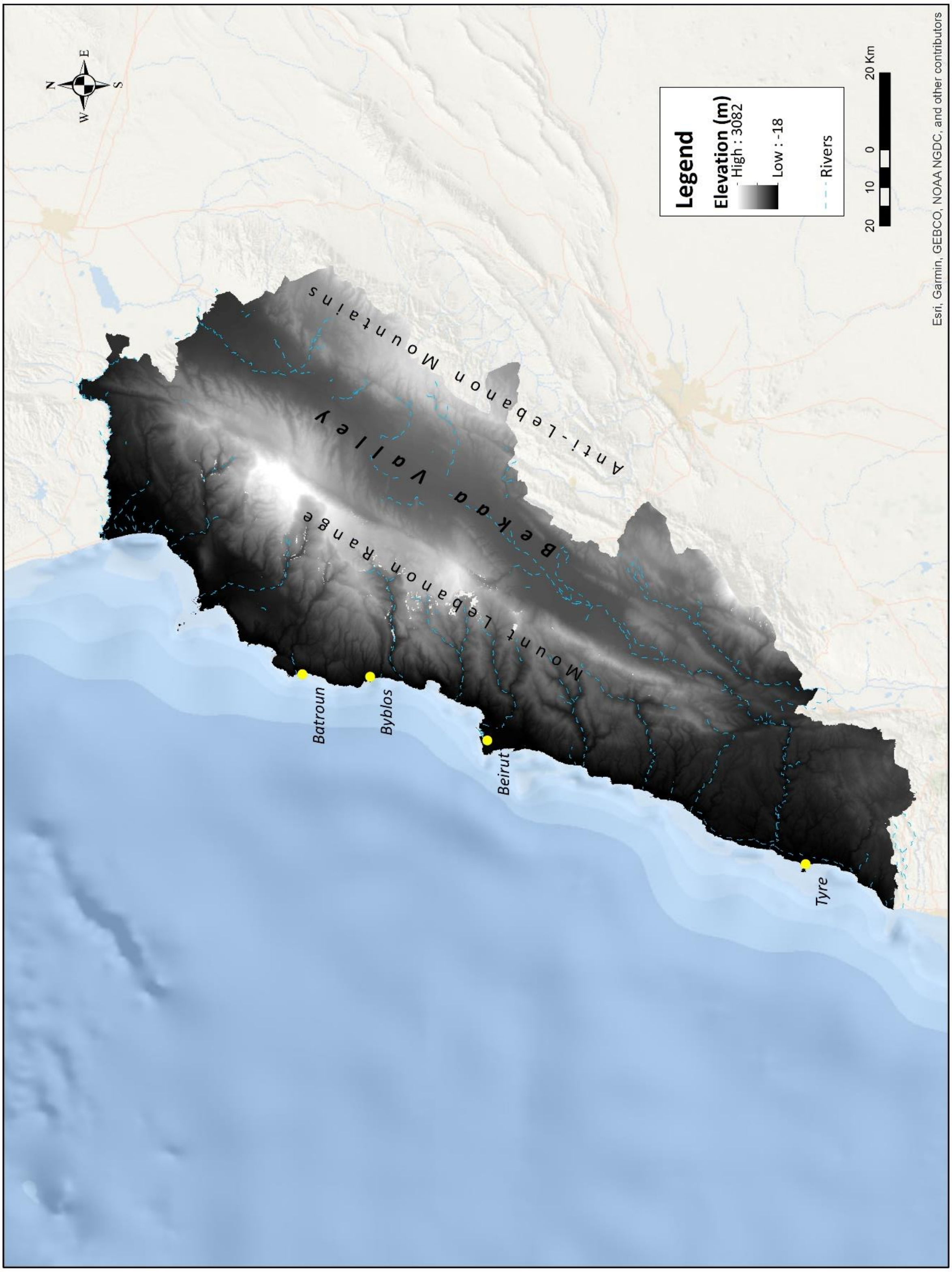

Figure 3.11: Topographic map of Lebanon, depicting the highest peaks in the Mount Lebanon Range east and north-east of Beirut

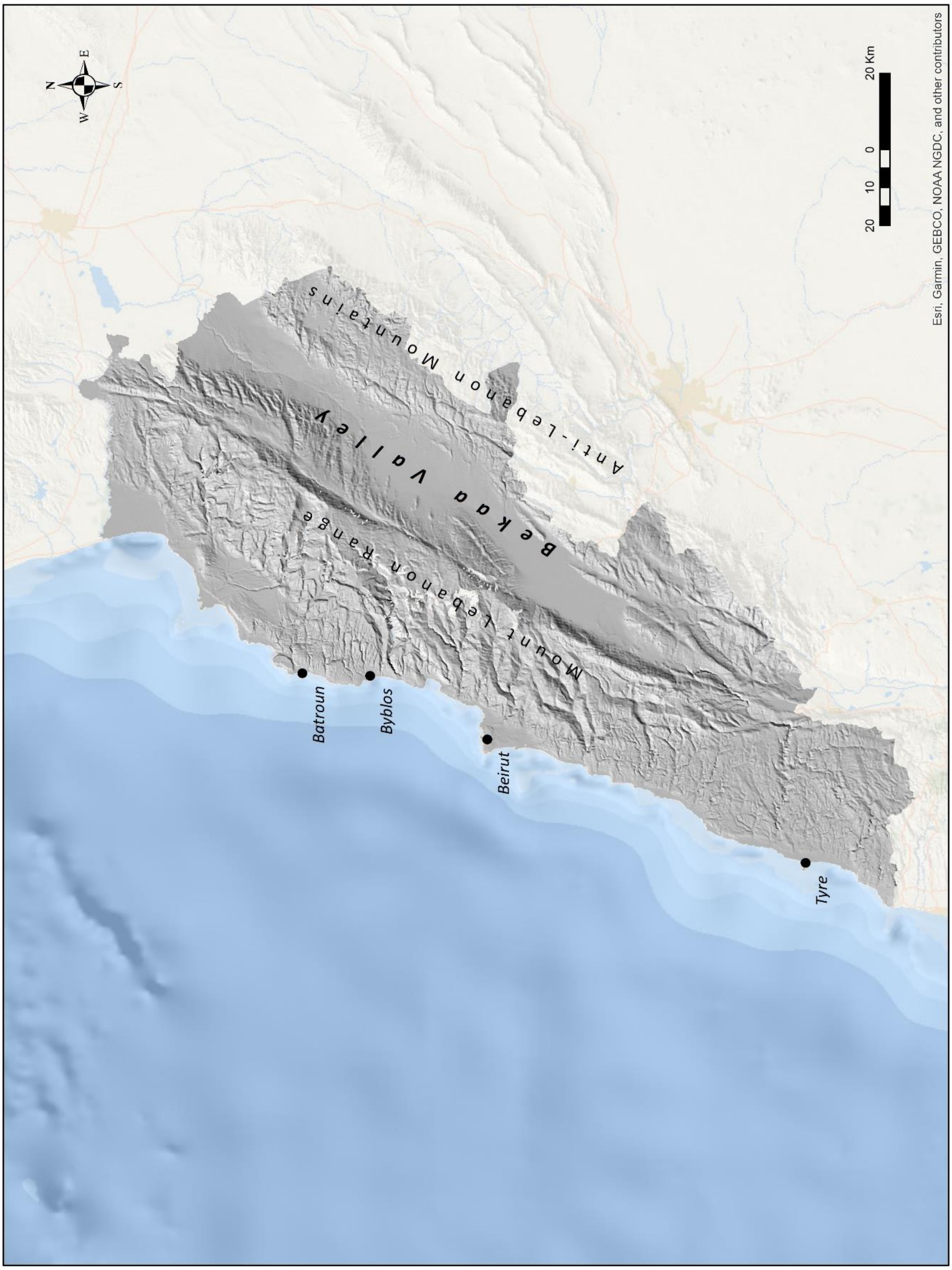

Figure 3.12: Topography of Lebanon depicted by hillshade

This pattern of a narrow coastal strip bordered by mountains persists further south with the Rosh Haniqra grottoes near Akko and the Mount Carmel Mountain Range. The Mount Carmel and Central Mountain Range in the southern Levant extend from Haifa to Jerusalem, with fertile lands lying in the northern portion of the range. East of this range lies the Jordan Valley, followed by the Abarim Mountain Range in Jordan. The Jordan Valley separates the coastal area from modern-day

Jordan, and is bordered by the Jordanian Plateau to the east. The Jordanian Plateau is surrounded by desert to the east and south, and the Hauran Plains in the northeast. South of the Carmel coast, the land is primarily flat and low. It is formed of wide coastal plains dominated by sand dunes that grow increasingly arid as one moves south (Goldreich 2003: 12-6).

3.1.3 **Rivers**

Fifteen main rivers flow along the western slopes of the Mount Lebanon Range, all of which are generally short and erratic, the largest of which are depicted in Figure 3.13 (Sanlaville 1977: 89-108). They start near the crest of the Mount Lebanon Range, and flow towards the Mediterranean Sea (Beydoun 1976: 314). The exceptions to this pattern are Nahr el Kebir (Nahr meaning river in Arabic) and Nahr el Litani, which are slower, meandering rivers that originate in flat areas. Two main geographical domains can be differentiated based on river flows. One is in the northern/central part of the country, in which rivers are generally short and flow in deep gorges from high sources (Marriner, Morhange and Beydoun 2008: 2500-1). The second can be specified in the southern part of the country, where elevation is lower and valleys are shallower and with a softer profile (Sanlaville 1977: 92). Lengths of the western extensions of the rivers (the portion that can be characterised as a single consistent stream flowing down from the mountain) generally vary between 50 km and 24 km, except for Nahr el Litani, which flows through the Bekaa Valley and is 145 km long (Sanlaville 1977: 89, 109; Semaan 2016: 62). Some of them dry out before reaching the coast, with only the well-watered rivers reaching the Mediterranean Sea.

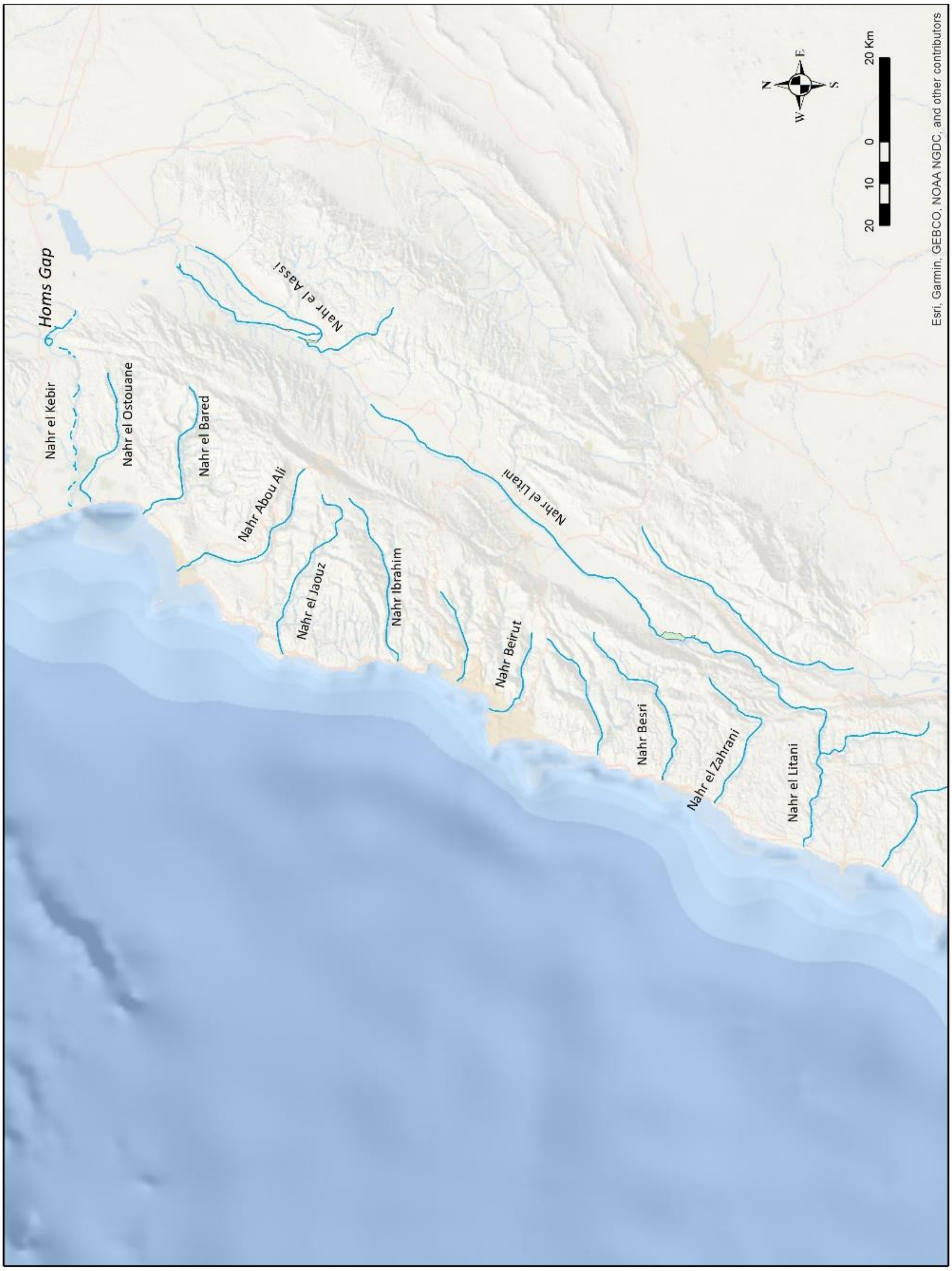

Figure 3.13: Main rivers of Lebanon

River basins are generally small in size, ranging from 1000 km^2 for Nahr el Kebir to 333 km^2 for Nahr Ibrahim, and flows are low and seasonal (Sanlaville 1977: 91). In Autumn, flows increase slowly since rainwater is largely absorbed by surrounding vegetation and soil. In Winter, flows strongly increase due to increased precipitation (Sanlaville 1977: 97, 104). This is followed by rainfall and snowmelt at the end of Winter and beginning of Spring, sometimes accelerated by the warm *khamsin* wind (Sanlaville 1977: 97, 106, 108; Semaan 2016: 62-3). This seasonality in flow rate and discharge is quite extreme, as nearly four fifths of the annual river flow occurs in Winter and Spring, with perennial or semi-perennial flow maintained by smaller springs during Summer and Autumn (Beydoun 1976: 317). Certain rivers are completely seasonal, such as Nahr el Fidar, and completely dry out in Summer (Sanlaville 1977: 97).

As a result, the rivers depicted above are, and likely were in Antiquity, difficult to navigate (Butcher 2003: 133-4). The main exception to this rule might be in the north-eastern part of the country, where Nahr el Aassi becomes the Orontes River, flowing northward into Syria (Pamir 2013). This river represents a different system from the Mount Lebanon Rivers, and flows much more consistently. It is around 610 km long with a basin of around 23,000 km^2 (Semaan 2016: 63), and is one of the few rivers that is navigable in the area, primarily between Antioch and Seleucia Pieria in western Syria (Strabo *Geog.* 16.2.7). As it flows south, navigation with large ships would have proven quite difficult; smaller rafts could have been used as the river neared the Lake of Homs and continued into Lebanon. Such a strategy could also have been utilised in the lower reaches of more consistent rivers in Lebanon (Butcher 2003: 134). This is corroborated by the possible correlation between the rivers of Lebanon and the development of important port cities throughout history (Tyre with Nahr el Litani, Sidon with Nahr Besri, Beirut with Nahr Beirut, Byblos with Nahr Ibrahim, Tripoli with Nahr Abou Ali or Qadisha River). They likely served as steady sources of fresh water for the population, and possibly allowed the transportation of logs from the hinterland towards the coast (Francis-Allouche and Grimal 2016: 245, 276; Frost 2000).

3.1.4 **Agriculture**

While these rivers play a part in providing irrigation for crops, and can be manipulated to direct water flow, a particular combination of temperature, precipitation, soil type and landscape allows for certain crops to prosper without significant artificial interference (see Figure 3.14 and Figure 3.15; details discussed in Appendix A). Often associated as ‘Mediterranean crops’, these generally include figs, dates, citrus, cereals, grains and various legumes, among a variety of other fruits (Tous and Ferguson 1996). As it is outside the scope of this thesis to explore all Near Eastern crops, and the primary products of focus are wine and olive oil, this section assesses the biological characteristics of the olive and the grape, and details some general patterns regarding their agriculture in the Levant.

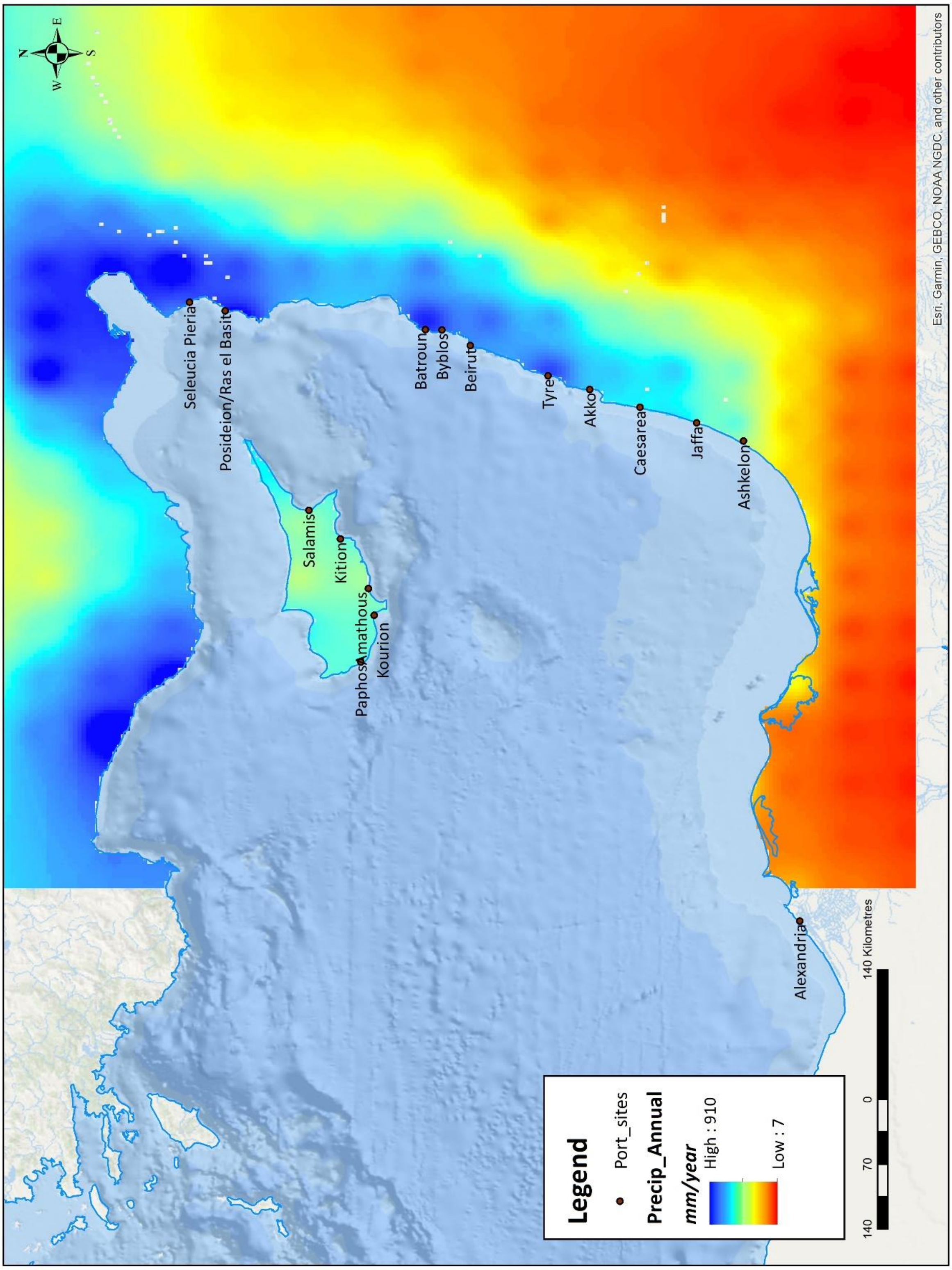

Figure 3.14: Average yearly precipitation in the eastern Mediterranean from 1901-2018 (data acquired from Harris et al. 2014)

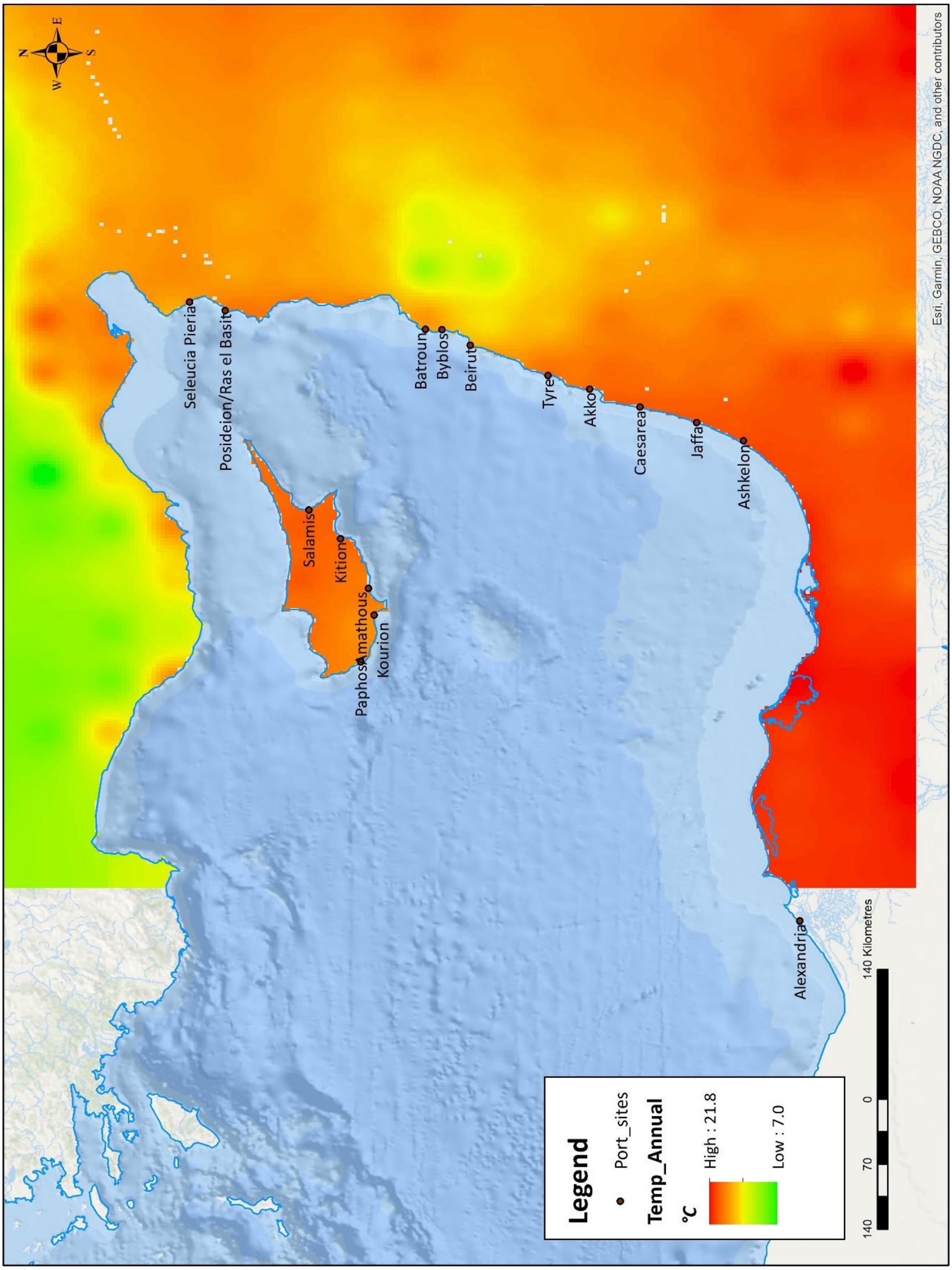

Figure 3.15: Average yearly temperature across eastern Mediterranean (data acquired from Harris et al. 2014)

3.1.4.1 Olives and Olive Oil

One of the primary plants of the Levant is the Mediterranean olive tree (*olea europaea* ssp. *europaea* var. *sylvestries*, a wild olive tree, and *olea europaea* ssp*. Europaea* var. *europaea*, a cultivated olive tree). This species is distributed throughout the Mediterranean (see Figure 3.16), though it is rather difficult distinguishing between each variety in the archaeological record (Waliszewski 2014: 73). It was recognised as nutritionally valuable possibly around 7000 BC, though it is difficult to specify a date of cultivation (Fabbri et al. 2004: 3). In the Levant, the tree covers the majority of Lebanon, certain parts of the southern Levant and north/north-western Syria.

The olive tree flourishes in subtropical climates with mild, rainy winters and long, warm, dry summers. It will thrive in the range of 3-4 °C in winters and 33-36 °C in warm periods, though it can survive in temperatures above 40 °C. Temperatures below -5 °C can kill smaller plants and branches, and -10/-12 °C can kill mature plants (Waliszewski 2014: 73). Thus, it is not expected to prosper at higher altitudes, especially in snowy climates (Fischer-Genz 2016: 59). It can grow with less than 220/200 mm of annual precipitation, but is more commonly found in regions that receive between 400-600 mm, with optimal conditions near 800 mm. The tree is quite drought resistant, but will not provide optimal yields below the 800 mm mark. This rainfall is especially crucial for fruiting in September, and a significant rainfall will increase the yield at this time (Waliszewski 2014: 75). It is well-adapted to most well-drained soils in the Mediterranean except for clayey or stoney and shallow soils, or on lower river terraces (Waliszewski 2014: 75).

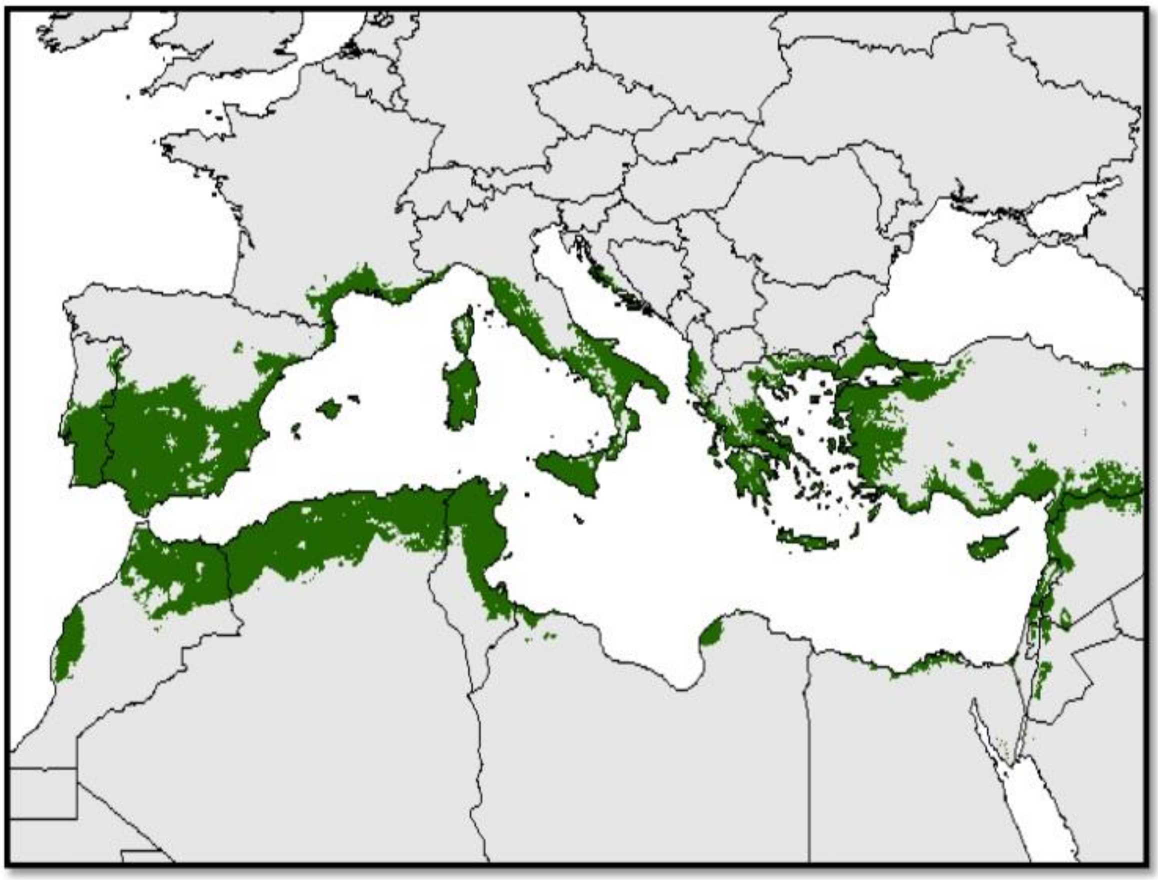

Figure 3.16: Distribution of the Mediterranean olive tree (after Moreno 2014: 21, Fig. 2)

The annual cycle of the olive tree is quite consistent and requires specific climatic conditions. At the end of February or beginning of March, the tree will undergo vegetative revival after a period of stasis. Flower clusters begin to open, and in May this leads to full flowering. Fruit development begins in June or July with the lignification of the stone and fruit colouring and maturation, ending in October. This closing phase requires a dry and warm climate for the fruit's maturation and oil content. Green or ripened fruits are usually harvested during late September and early November, but a late harvest could happen as late as December or January. After this time, the tree will return to vegetative stasis between November and February, requiring a lower temperature (Fabbri et al. 2004: Waliszewski 2014: 74).

The olive is commonly crushed and pressed to extract its oil, with the green olive generally regarded as the source of a higher quality oil and the purple-brown type utilised for a common oil. The simplest method to do this is by crushing the fruits with stone tools, then adding boiling water and skimming the oil from the surface (generally done in the Neolithic and Chalcolithic periods). More advanced techniques were developed by squeezing olive pulp (Parain 1962), but productivity was still low. These techniques were refined over several millennia, and eventually led to larger sites that industrialised the process. This is discussed further in Chapter 6.

3.1.4.2 Grapes and wine

The grapevine, similar to the olive tree, flourishes throughout the Mediterranean, and has been cultivated around the world. *Vitis vinifera*, the grape native to the Mediterranean region, likely originated in Asia Minor and spread south and west (Frankel 2016: 551). It was originally consumed as a fruit and product in itself, but at least by around 7000 BC, humans began to process it into wine (Creasy and Creasy 2018: 7). The plant is able to withstand more difficult conditions than the olive tree, though the nature of its environment will ultimately affect the fruit. As a result, the distribution of vineyards is quite extensive, stretching across the Mediterranean and Europe into the Black Sea region and beyond (see Figure 3.17).

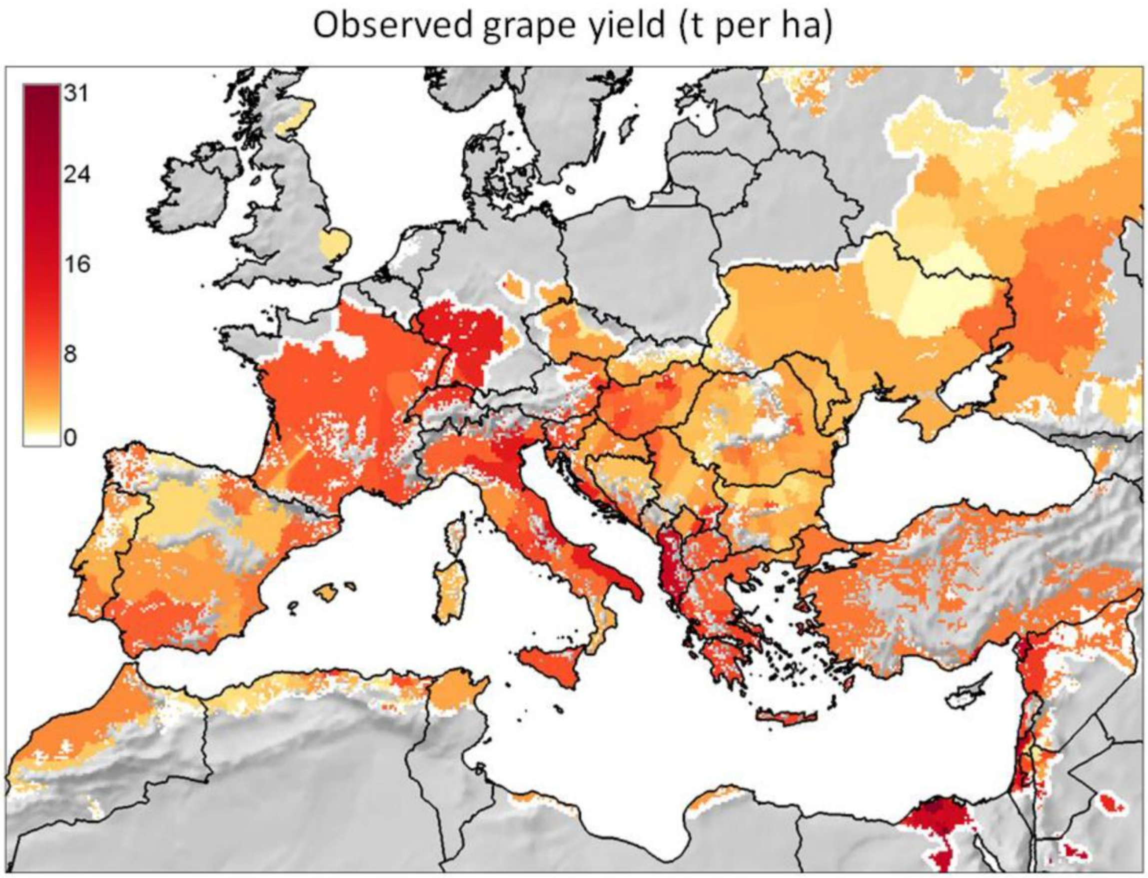

Figure 3.17: Vineyard coverage of the Mediterranean and surrounding region in 2000 (after Ponti et al. 2018: Fig. 4)

Grapes thrive in a similar climate to that of the olive, ideally with temperatures ranging between -1°C and 19 °C. They require long, warm, dry summers and cool, rainy winters, without a significant degree of humidity. Climates that are on the cooler end of the possible climatic zones for cultivation have been known to produce a higher quality wine due to a high degree of acidity and a good colour on the grapes. Conversely, warmer areas tend to produce a lower quality wine since the ripening period proceeds much more quickly, resulting in a harsh, coarse taste in the harvested fruit (Winkler et al. 1978: 60). In terms of required precipitation, it is comparable to the olive tree, requiring a wet Winter and, crucially, a dry late Spring, Summer, and early Autumn. This can be supplemented through irrigation.

The grape also mirrors the olive tree in its phenology, going through periods of dormancy and fruiting based on temperature and precipitation. The vine begins to emerge from dormancy as soil temperature starts to rise, near the end of Winter. Buds emerge when the temperature reaches 10°C, and shoots begin to grow. This can occur at different times depending on environmental conditions. In May and June, buds begin producing flower clusters which open in preparation for pollination. This culminates in July and August when the vines mature and veraison begins, revealing the pigment of the grape. In the proceeding period, the grapes mature and are harvested according to the desired level of ripeness. The plants will return to stasis until the cold period ends once again (Creasy and Creasy 2018: 34-78; Winkler et al. 1978: 104-10). While the only real ecological threat to the olive tree is the olive fruit fly (*Bactrocera oleae*), the grape is seasonally colonised by herbivores and vulnerable to a variety of pests and pathogens (Ponti et al. 2018). As a result, a higher degree of maintenance is required. Vines must also be pruned in preparation of the end of the stasis period and the emergence of new buds, resulting in the bleeding of sap. For large vineyards, this entails an enormous input of labour (Purcell 1985: 4).

In order to process the fruit into wine, it needed to be harvested, crushed, squeezed and fermented. Though the fermentation process in the Roman period is difficult to ascertain, archaeological remains and ancient texts shed light on the process of transforming massive quantities of grapes into juice (Cato *De agricultura* 104-15). Crushing would have usually been done in large wooden basins to prepare the pulp, which could then be transported in baskets to the wine press (Waliszewski 2014: 118-9). This process is also discussed in more detail in Chapter 6.

3.1.5 **Discussion**

The distribution of modern vineyards and olive groves in the Levant appears to be correlated with regions of higher precipitation (generally above 400 mm/year), characterised by hot, dry summers and cool, rainy winters. There is a clear prevalence of their agriculture closer to the coast, though the Mount Lebanon Range in Lebanon and the western slopes of the Anti-Lebanon Mountains are possibly even better suited for orchards based on elevation, precipitation, temperature and soil composition. In Chapter 6, I compare the archaeological evidence of wine and oil presses in Lebanon with a particular focus on Beirut to compare the data presented here with production in the Roman period. In essence, the fact that Beirut wine and olive oil was being produced and distributed at this time and in this specific region is, in some way, related to the climate and geological characterisation of the area. However, it must be recalled correlation does not always mean causation, though they are thoroughly intertwined concepts (Pearl 2009: 42). Let us briefly explore the complexity of this statement with regards to viticulture in the Near East. One possible hypothesis to present is that:

> Ancient settlements along the Levantine coast are correlated with wine production.

In this regard, we are specifying two important factors. Firstly, that ancient settlements in the Levant have a higher probability of being involved in wine production than ancient settlements in other regions; and secondly, that wine production is more likely to have occurred in the Near East than in other locations. Though there is an implicit relationship between these two statements, and we can almost say that there is some weak tie between wine production and ancient Levantine settlements beyond simple correlation, the clues and assumptions that lead us to any confirmation are largely subjective and situational (Pearl 2009: 42-3).

One of these clues is temporal precedence (Pearl 2009: 43). The mere existence of grape vines prior to human cultivation in the Levant (Tengberg 2012: 186-90) would suggest some causal relationship between the environment and human exploitation. For example, in Lebanon, given the climate being conducive for the agriculture of grapes and olives, it is possible to make the statement that ancient populations grew grapes due to the fact that it was easier than growing other crops. To some degree, they produced wine and oil *because* of the environmental and ecological geography of the area. This is corroborated by the initial gathering of wild grapes prior to evidence of cultivation and processing (Tengberg 2012: 186, 190).

However, the production of wine and oil had been prevalent in the Near East for thousands of years prior to the arrival of the Romans (Waliszewski 2014: 46). In this way, there is some continuity in behaviour between people over time. People grew grapes and olives and made wine and oil based on what the previous generation did. They used the same methods as their predecessors because these methods were effective. Thus, the continuity in communities can also be characterised as a causative factor in the production of wine and olive oil in the Levant based on temporal precedence. To some extent, any examined generation that produced olive oil and wine in Roman Beirut did so *because* the previous generation did also.

Another clue that helps differentiate correlation from causation is the fluidity of movement at examined sites. In a terrestrial setting, this refers to the ease with which product could be transported from production centres to distribution centres. As will be seen in Chapter 6, oil and wine presses can be found in the environs of Beirut. Their emergence as relevant agricultural quarters in the Roman period and their commercial connection with Beirut must have, in some way, been related to the ease with which product could be taken to the city. Logically, this successful function of a site is largely based on its geographical situation. It would help differentiate agricultural sites in the Roman period that participated in distribution networks from smaller farms intended solely for self-sustenance.

3.2 **The Sea**

In a maritime setting, the fluidity of movement applies to the accessibility of various Roman harbours in the study region as well as sailing conditions. While these factors should not be taken as causative in nature (merchants did not necessarily go from point A to B *because* it was most efficient based on the maritime environment), the comparison of routes suggested by sailing conditions to the actual routes taken takes us a step beyond simple correlation. By contextualising ceramic data with wind regimes and currents, it is possible to provide umbrella statements (merchants were transporting wine or olive oil from Beirut to 'X' in the 1st century AD) and then refine these statements according to environmental factors (merchants transporting wine or olive oil from Beirut in the 1st century AD probably sailed in Spring and stopped at ports X and Y along the way).

In the same way that the terrestrial ecology of the Levant helps us understand the macro processes at play in urban and rural development, maritime conditions portray the environment in which merchants were able to transport products from port to port. Wind regimes and currents likely shaped the common maritime routes that emerged over time for ancient societies (Whitewright 2008: 47). This is not to suggest that seasonal patterns universally dictated sailing times and destinations; however, these patterns were recognised by ancient authors in the Hellenistic and Roman periods (Arist. *Mete*. 2.6; HDT 4.152; Pliny *HN* 6.21; Thuc. 7.5; Xenophon *Hell*. 2.3.31) and, thus, must have been quite familiar to sailors that frequented the region. Seafarers in the Roman Levant exploited wind regimes in order to achieve successful journeys, and were sometimes delayed by unexpected adverse conditions (Pliny the Younger *Epist*. 10.15; Whitewright 2007: 78). Additionally, environmental conditions would have affected the accessibility of ports along the coasts of the Levant and Cyprus.

It has also been suggested based on ancient texts that merchants saw the north-eastern Mediterranean region as a distinct maritime zone, with another zone connecting Cyprus, Egypt, the southern and central Levant and the Aegean (see Figure 3.18) (Strabo *Geog*. 6.3.6, 14.6.1; Arnaud 2011: 61). These characterisations have been further divided elsewhere based on a wider range of sources, with a Cypriote Sea in the north-east, a Syrian/Levantine Sea and a Carpathian

Sea adjacent to Crete (Figure 3.19) (Arnaud 2001-2002: 174-5). With regards to the Levantine coast, this is significant in the fact that the shore as a whole was considered as part of a single maritime entity. Despite provincial divisions, ancient authors seem to have viewed the seaboard of Roman Syria as a unified sea. Therefore, it is necessary to better understand the ecological and geological factors that influenced a harbour's degree of shelter, depth, and ultimately, its place within the wider network of harbours in the eastern Mediterranean. This description will prove quite revealing in later chapters with regards to the commercial distribution patterns of Beirut with the surrounding area.

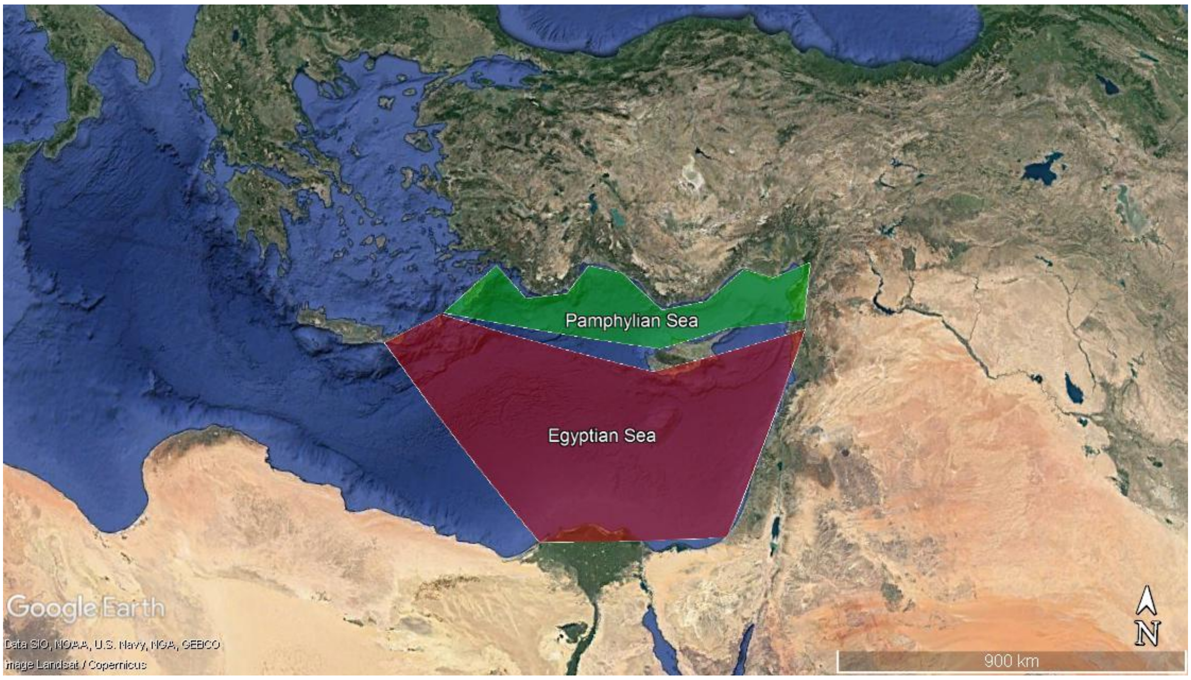

Figure 3.18: Geographical division of the eastern Mediterranean based on Strabo's account as interpreted by Arnaud (Strabo *Geog*. 14.6.1; Arnaud 2001-2002: 174-5)

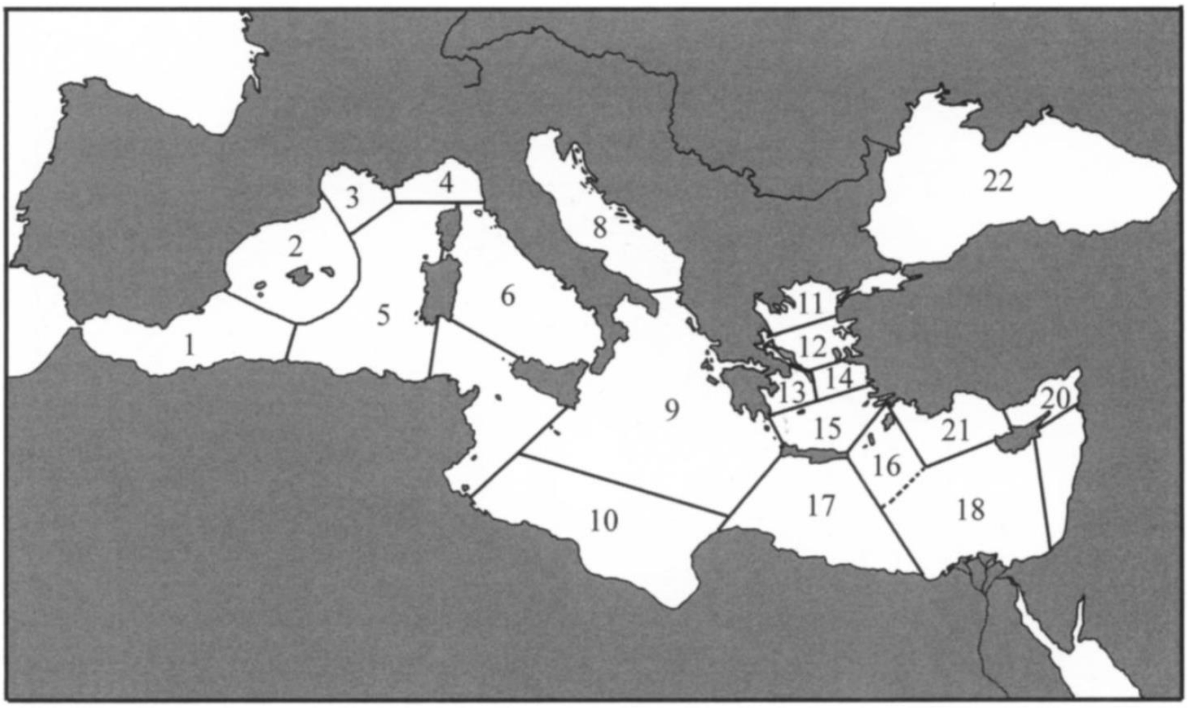

Figure 3.19: Geographical division of the Mediterranean based on wider variety of ancient authors; 20 represents Cypriote Sea, 21 represents Pamphylian Sea, 16 represents Carpathian Sea, 18 represents the Egyptian Sea, and unlabelled eastern section represents the Syrian Sea (after Parker 2008: 192, Fig. 21)

3.2.1 **Wind**

The wind regimes on the Levantine coast not only dictated routes for ancient seafarers, but also the time and date of departure from or arrival to certain ports. Wind regimes also aided with sailors' directionality in open waters (Davis 2001: 15). Specifically, the presence of a certain wind (or lack thereof) helped seafarers get their bearings. This value was also discussed by ancient authors in the past (Theo. *De Vent*. 37-43).

The patterns of wind regimes are often summarised as daily, monthly, or even yearly averages. However, these averages can only be considered at a macro-scale, and do not provide a full picture of temporal and seasonal patterns. Sailors would often exploit daily fluctuations in wind patterns to set sail with ease, including waiting for favourable nightly breezes to carry them out to sea (Heliodorus *Aeth*. 4.16; Beresford 2012: 206; Neumann 1973: 6; Simpson 1972: 145-6). For this reason, a consideration of temporal variations is crucial in better understanding maritime patterns on a smaller scale (Cavaleri et al. 1991; Safadi 2016; Stefanakos et al. 2004: 191). The conglomeration of daily and seasonal cycles ultimately compose what we perceive as overall patterns, but they must be considered individually to shed light on times and days of best accessibility of harbours, and optimal routes throughout the year. This is especially true along the

Levantine coast, where much of the shore is westward facing and exposed to dominant winds. Thus, daily cycles in wind patterns are quite important in determining the optimal times and points of departure and arrival.

The predominant winds of the eastern Mediterranean as a whole are usually characterised as north to north-westerly (Cavaleri et al. 1991: 10740-1; Davis 2001: 1-17; Safadi 2016: 354). Known as the *Etesian* winds, they originate in the upper Balkan peninsula, and blow through the Aegean with significant power. The *Etesian* winds are the resulting force from a stable high-pressure system over southern Europe and the Mediterranean and a corresponding low-pressure system over south-west Asia (Davis 2001: 17). They are prevalent roughly from the months of April to November, reaching their peak in July/August at a force of 6-7. As they progress further south away from the Aegean, they begin to veer and become westerly as they approach the Levant. Upon reaching the Levantine coast, they are primarily north-westerly winds, or westerly to south-westerly in the northern Levant (Safadi 2016: Figs. 4-7).

In the Levant, the *Khamsin* winds also periodically blow across the coast. They are hot, dry winds that derive from North Africa, and generally affect the Levantine coast in Spring, notorious for the increase in temperature they bring (Sanlaville 1977: 35). The *Khamsin* winds are generally southerly, and do not persist for long periods of time. They blow for intervals of up to a week, generally from the end of March to mid-April, though they have been known to sweep into Lebanon in the fall. In the north, north-eastern winds chill the plain of Akkar up to Tripoli in Winter (Sanlaville 1977: 35). These frequent and sometimes volatile winds result in quite a variance in temperatures, especially during the springtime (Semaan 2015: 65). They are quite significant in the Winter months, further accentuated due to the absence of the usually dominant *Etesian* winds.

However, the systems that ultimately dictate wind directionality and speed are quite complex, and cannot be summarised with a general discussion of dominant wind regimes. Firstly, localised features can often augment or diminish the speed of passing winds. Narrow straights, headlands, islands, valleys and other natural features can funnel winds to increase their speed (Leidwanger 2020: 32-33). This is the case in the Aegean, where the area between Samos or Euboea and the adjacent mainland funnels the *Etesian* winds, creating a wind with dangerous velocities, sometimes blowing with gale force (Davis 2001: 17). Secondly, diurnal winds can often affect wind directionality and strength throughout the day due to changes in temperatures between land and sea. In the evening, when temperatures inland are generally lower, an offshore breeze ensues, as the cold air is drawn towards the sea. The process is reversed during the day, when inland temperatures increase, and cold air is drawn in from the sea. Diurnal winds and breezes are most prevalent in the hottest periods, and can actually counteract the effects of dominant wind systems (Blue 1995: Ch. 4; Rougé 1966: 34). In the Summer, they prove to be quite significant, as their effect is quite consistent and strong; for this reason, the Summer months are likely quite preferable for navigation (among other reasons) (Whitewright 2008: 48). Through the exploitation of consistent diurnal winds in the Summer, it would have been easier to manoeuvre around coastlines and headlands, and also to access harbours during the day or exit harbours at night (Leidwanger 2020: 32).

Thus, the manifestation of all these effects into a single directionality and speed at a specific point in time and space oversimplifies a complex and dynamic system. Safadi (2016) has processed offshore and onshore wind data from 1992-2002 in the eastern Mediterranean to better understand daily and seasonal fluctuations, creating more specific, regional characterisations of the wind systems on the Levantine coast. Results are depicted in the figures below and summarised in the following sections, allowing an examination of daily wind cycles in the Levant and Cyprus throughout the year.

3.2.1.1 Autumn

The wind speed in the region is generally low at the coast, especially in Autumn. At the southern-most part of the Levant, the morning wind blows at a Beaufort Scale 2. These light winds are generally south-easterly, though directionality is quite erratic further away from the coast. Further north, near Caesarea, the regime becomes southerly at a Beaufort Scale 3, continuing northward into Lebanon. In the afternoon, speeds pick up to Beaufort Scale 3 throughout the entire southern Levant, and become north-westerly, blowing towards the coast from the eastern part of the Sinai Peninsula to Tyre in Lebanon.

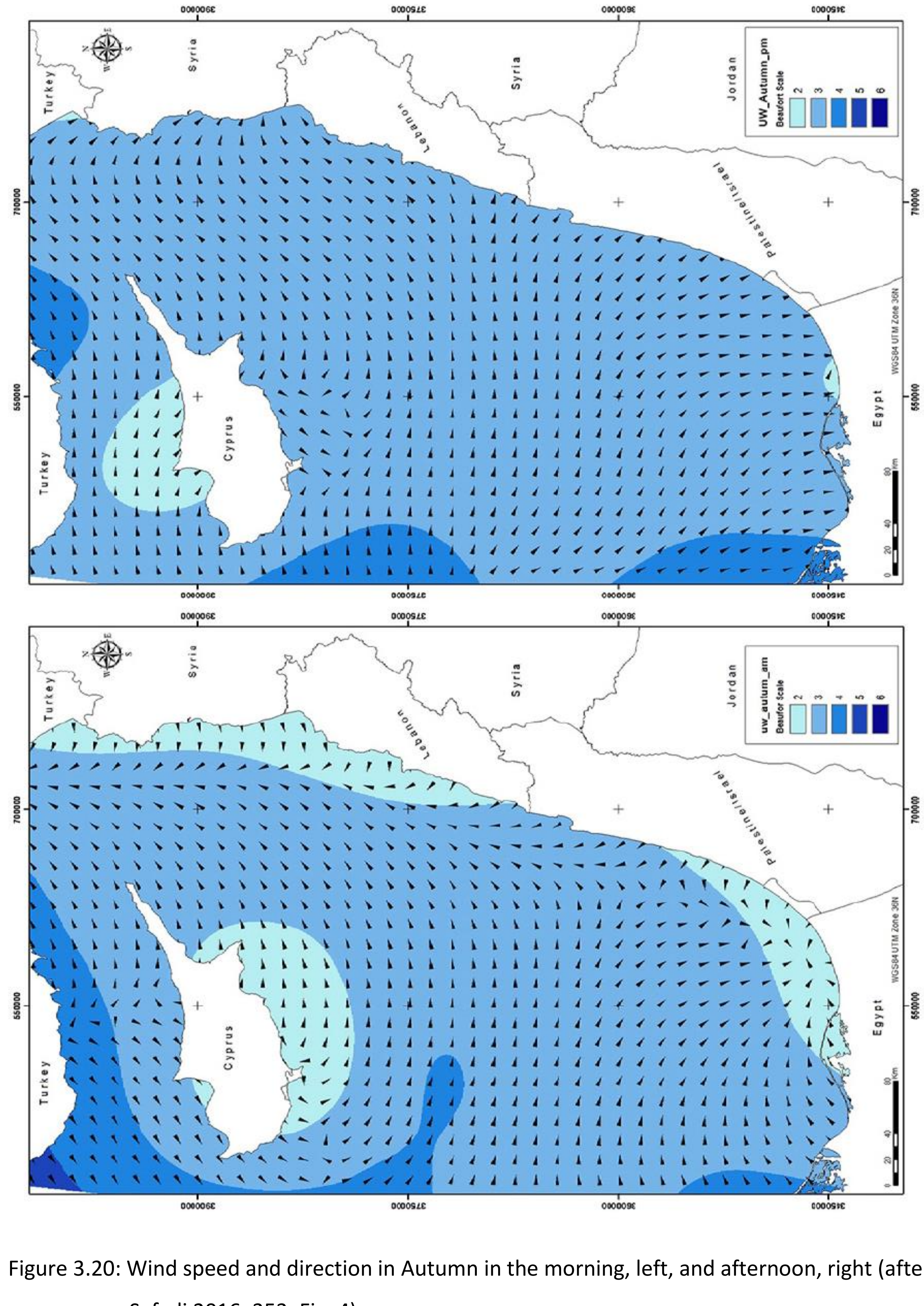

Figure 3.20: Wind speed and direction in Autumn in the morning, left, and afternoon, right (after Safadi 2016: 353, Fig. 4)

In the central Levant, winds appear to be southerly to south-easterly in the morning up to Beirut, where they become predominantly easterly. Speed is slower in this region at a Beaufort Scale 2. As the change in directionality seems to occur predominantly in the lee of the headland of Ras

Beirut, it is possible that diurnal winds, which are winds related to the cycle of on and offshore breezes caused by temperature variations between land and sea throughout the day (Leidwanger 2020: 32), are the primary influence on this variation since the projector would provide some shelter from dominant winds. In the morning, the inland may still be cooler than the offshore region, drawing the cooler air towards the sea. In the afternoon, the south-westerly winds dominate starting at Tyre, and continuing north. In the northern Levant, gentle winds blow away from the coast in the morning, similar to the pattern observed north of Beirut. In the evening, speeds pick up to a Beaufort Scale 3 and become north-westerly, with a foci of change near Tartus in Syria.

3.2.1.2 Winter

Wind patterns in the Winter are more difficult to characterise, as directionality and speed are erratic due to regional variations and seasonal winds. In the morning, from the southern-most point in the Levant to the region around Tyre, winds blow in a southerly to south-easterly direction. The southern-most regions blow at a Beaufort Scale 2, picking up near Caesarea to a Beaufort Scale 3. In the afternoon, directionality shifts drastically, with strong westerly to south-westerly winds blowing at a Beaufort Scale 3-4 in the south and north-westerly winds at Haifa. This change in directionality is centred around the region of Caesarea.

In the central Levant, winds in the morning are generally southerly to south-easterly at a Beaufort Scale 3 in south Lebanon and 2 in central/northern Lebanon, shifting directionality near the region of Beirut. In the northern part of the country, they become north-easterly, especially around the region of Tripoli. In the afternoon, north-westerly winds of a Beaufort Scale 3 blow in the southern part of Lebanon, changing direction near the region of Tyre and becoming south-westerly until Tripoli, where they shift to become westerly. In the northern Levant, morning winds are generally easterly to south-easterly, blowing away from the coast at a speed of Beaufort Scale 3. In the afternoon, this shifts entirely, as they become westerly and blow towards the coast. Offshore, roughly 50-60 km away from the coast, speeds pick up drastically, reaching a Beaufort

Scale 4 in the morning and evening.

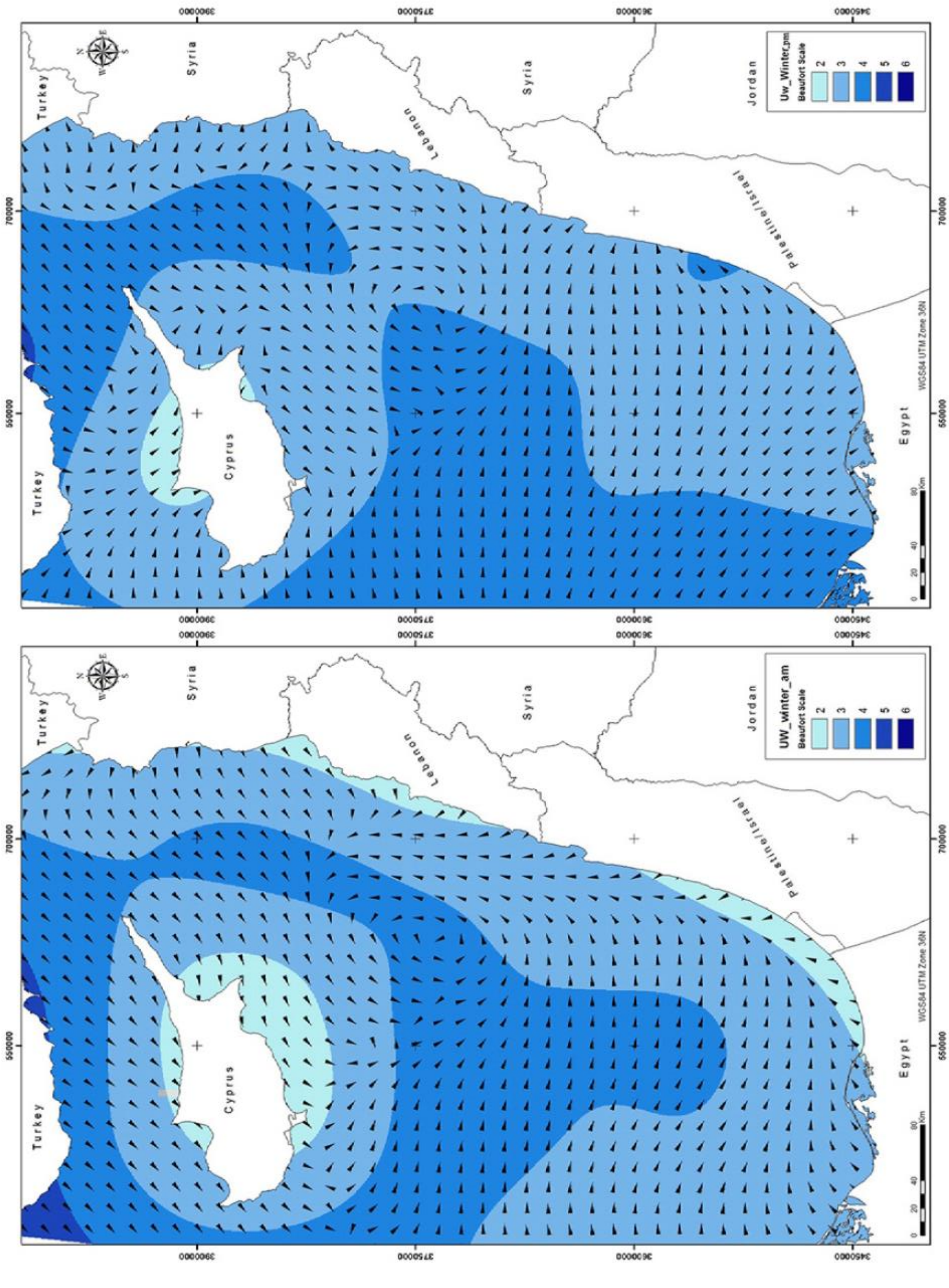

Figure 3.21: Wind speed and direction in Winter in the morning, left, and afternoon, right (after Safadi 2016: 354, Fig. 5)

3.2.1.3 Spring

In Spring, the *Khamsin* winds become prevalent, creating a consistent southerly to south-easterly flow in the morning throughout the southern Levant. At the southern-most tip of the Levant near the Sinai Peninsula, winds blow at a Beaufort Scale 2, picking up in speed near Jaffa, and slowing near Haifa Bay. They are generally easterly, with a slight directional change at Caesarea to south-easterly. In the afternoon, the pattern shifts to strong north-westerly winds at a Beaufort Scale 3 and even 4 at Jaffa and Ashkelon. These patterns continue north till Tyre.

In the central Levant, winds blow in an easterly direction in southern Lebanon, shifting to north-easterly in central and northern Lebanon. They are calmer around Tyre, at a Beaufort Scale 2, picking up to a Beauford Scale 3 in the central and northern portion of the country. In the afternoon, the pattern reverses, with north-westerly wind hitting the southern coasts until Tyre, before shifting to south-westerly winds throughout the central and northern coasts. In the northern Levant, morning winds are predominantly northerly at a Beaufort Scale 3. In the afternoon, they become westerly, blowing towards the coasts at a Beaufort scale 3 with little to no variation or fluctuation.

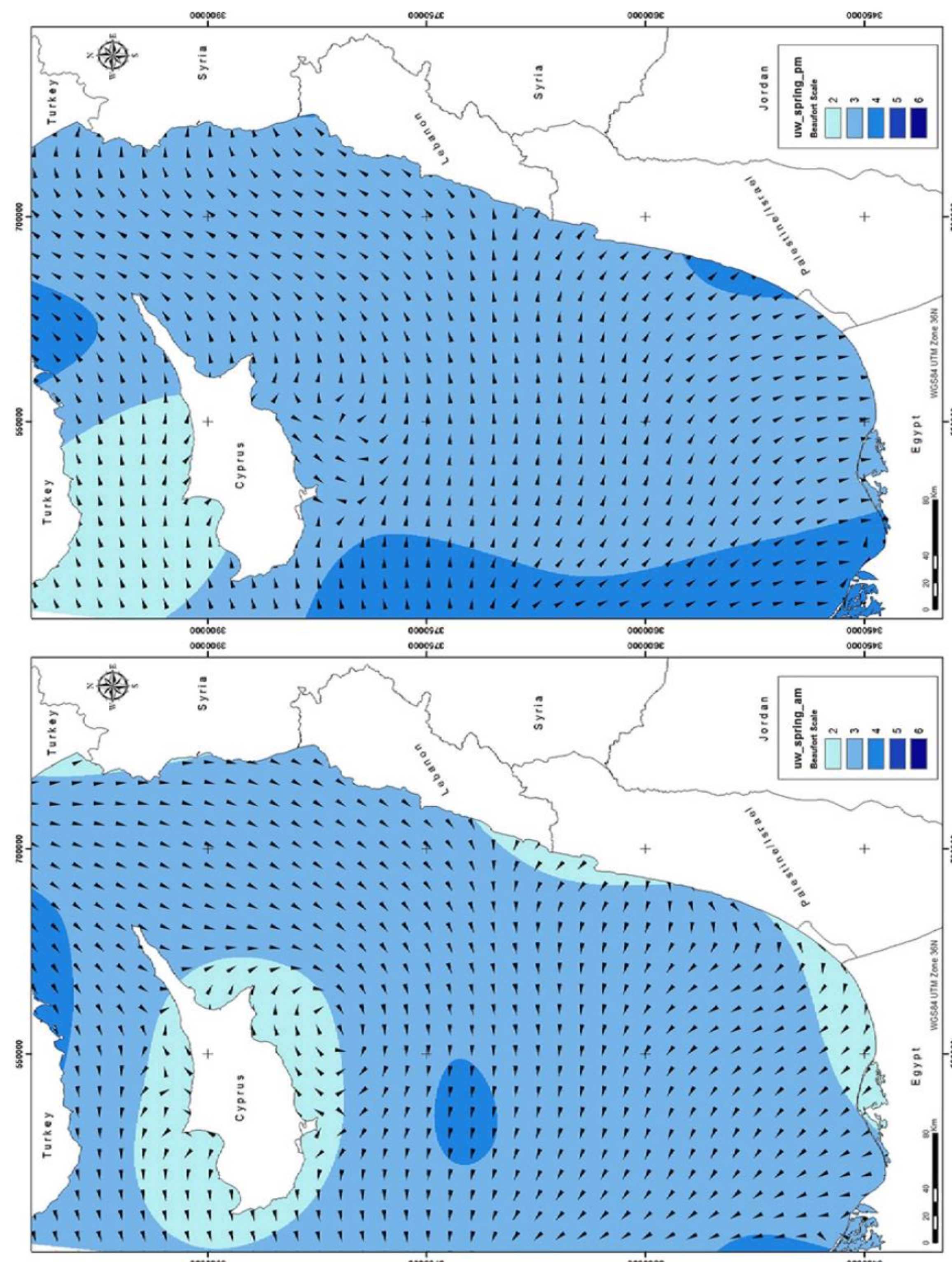

Figure 3.22: Wind speed and direction in Spring in the morning, left, and afternoon, right (after Safadi 2016: 355, Fig. 6)

3.2.1.4 Summer

Wind directionality and speed seems to be most consistent throughout the day in the Summer months. In the morning, winds are predominantly south-westerly along the entire Levantine coast, progressively becoming more southerly as they progress north. At the southern-most tip of the Levant, they are westerly to north-westerly, quickly shifting to south-westerly near Ashkelon. They are quite calm throughout the southern Levant at a Beaufort Scale 2, before picking up speed to 3 at Sarepta in Lebanon. Near Tartus, they shift to become predominantly southerly and continue north at a Beaufort Scale 2.

In the evening, winds are stronger and there is some regional variation. In the southern Levant, winds are north-westerly near Ashkelon, transitioning to westerly near Caesarea before again becoming north-westerly around Haifa till Tyre. North of Tyre, they become predominantly south-westerly and pick up speed north of Beirut near Jounieh, Byblos and Tripoli in northern Lebanon.

In Syria, they return to a Beaufort Scale 3 and seem to be predominantly westerly.

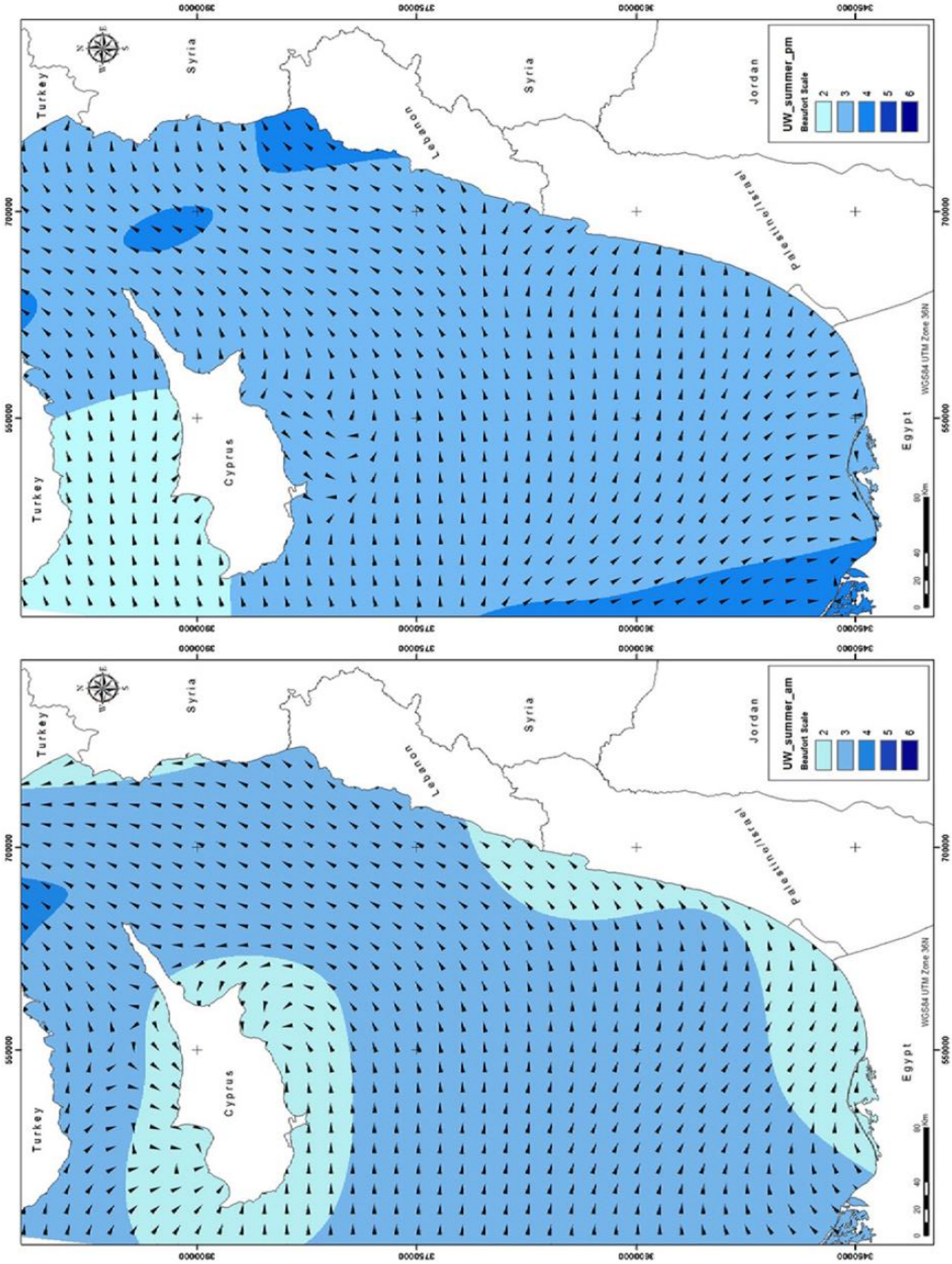

Figure 3.23: Wind speed and direction in Summer in the morning, left, and afternoon, right (after Safadi 2016: 355, Fig. 7)

3.2.2 **Currents**

Tides in the Mediterranean generally did not effect significant sea-level change, and lunar tides are essentially a non-factor in the Mediterranean (Beresford 2012: 100). For example, the tidal range in northern Syria, is small, ranging between 20 to 40 cm (Sanlaville et al. 1997: 385). In the Adriatic, where tidal fluctuations are higher than average compared to the rest of the Mediterranean, the tidal range is less than 80 centimetres (Beresford 2012: 100). With the tide in the eastern Mediterranean being relatively negligible, the flow of water and the rise and fall of sea-level is dictated more by wind, evaporation, and other external factors (Blue 1995: Chapter 4).

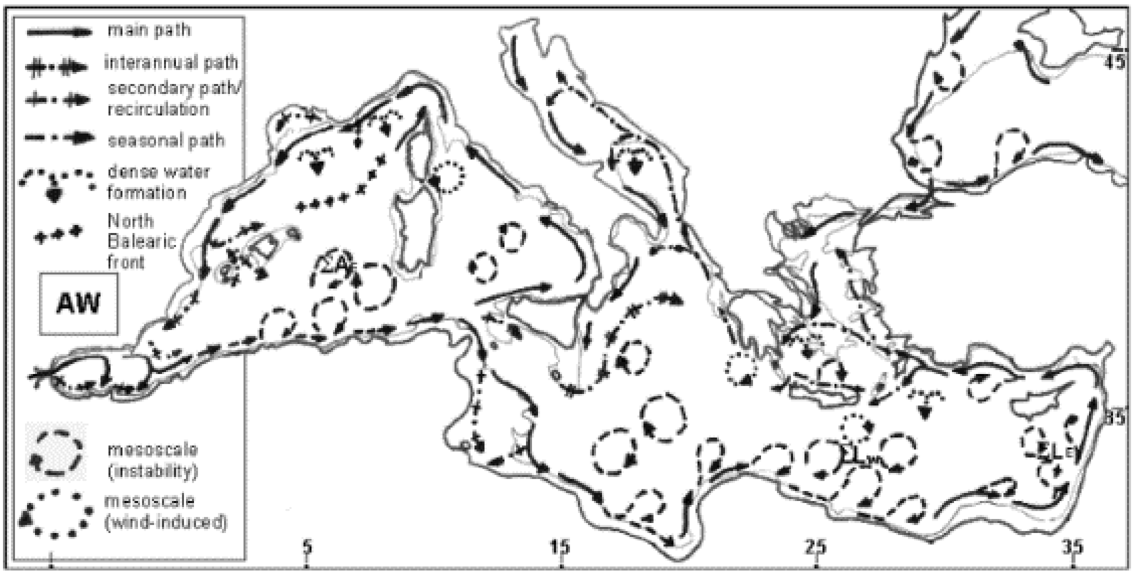

Figure 3.24: Currents in the Mediterranean (after El-Geziry and Bryden 2010: 42, Fig. 3)

Except for areas through which water is funnelled, resulting in a stronger current, surface currents are generally dictated by the wind (see Figure 3.24), especially in open areas unprotected by land masses (Beresford 2013: 222; Raban 1987). The culminate effect is difficult to specify, though current speed in the eastern Mediterranean is quite low, with a steady mean rate of .25 to .5 knots along the coasts of Israel, and .5 knots farther north. Essentially, since tidal currents are not prevalent in the eastern Mediterranean and especially along the Levantine and Cypriote coasts, surface currents can be regarded as directly related to winds. More specifically, currents can be more definitely characterised by fetch and swell. Fetch is the expanse of open sea over which wind travels, which influences the effect of the wind on the sea, while swell is the subsequent product of the wind’s effect on the sea, and is roughly proportional to the square-root of the fetch. The swell is thus dependent on the wind (duration and strength) as well as the length of the fetch (distance of open sea) (Blue 1995: Chapter 4).

Thus, the seasonality in currents in the eastern Mediterranean can also be related to seasonal variations in wind patterns. In Summer and Autumn months, *Etesian* winds are quite predominant (see Figure 3.20 and Figure 3.23), and currents are essentially an accentuation of these patterns. Flood currents likely set east and ebb currents likely set west, but the small tidal range indicates that currents are easily influenced by the winds. The flood current is likely accelerated by westerly winds, and retarded by easterly winds, with the opposite being true of ebb currents (National Geo-Int Agency 2017: 47). In this way, currents in the Summer and Autumn would likely be most pronounced, and augment the effect of the dominant *Etesian* winds.

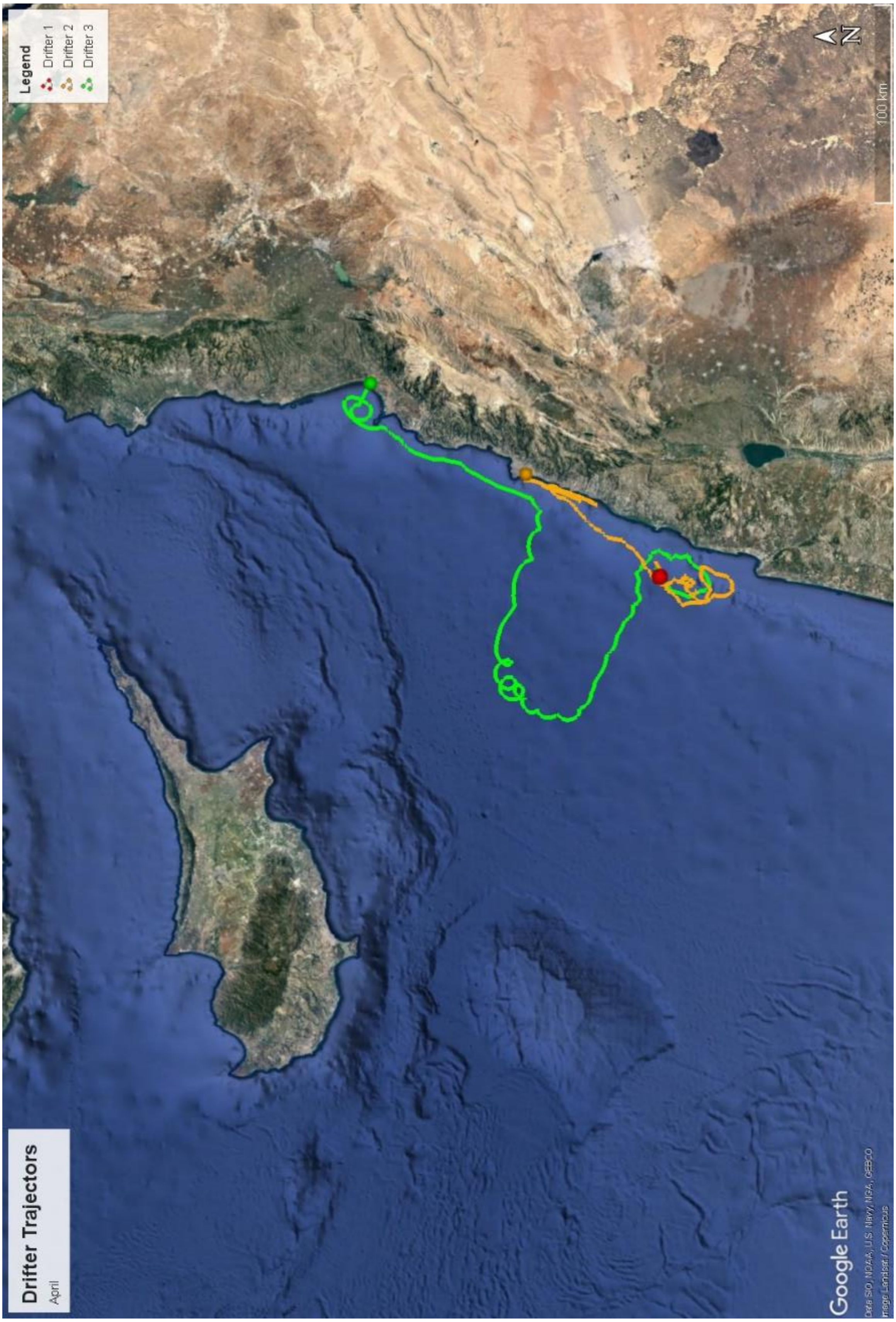

Figure 3.25: Trajectory of ALTIFLOAT drifters released April 15, 2013 around 8:00 (data acquired from OGS)

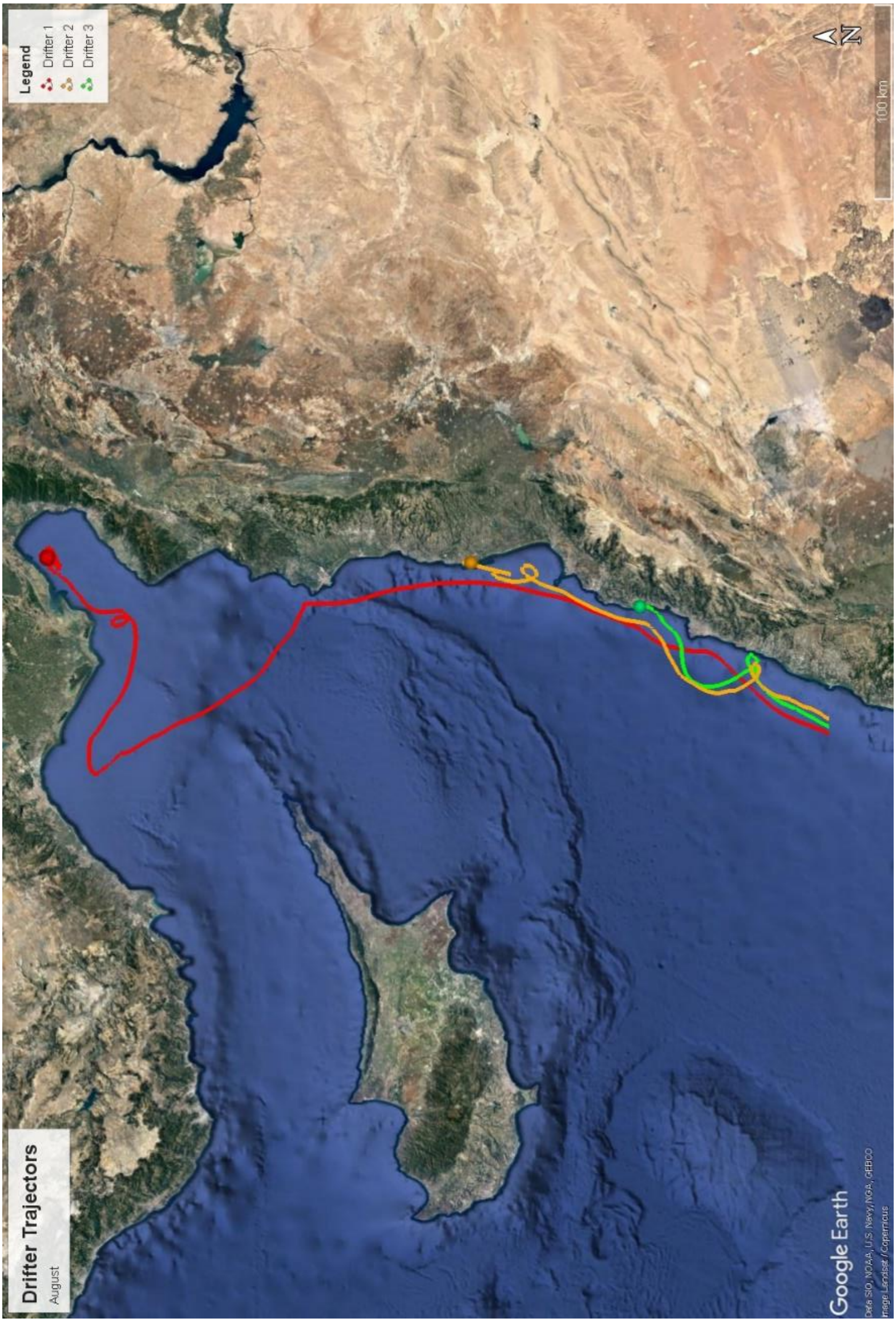

Figure 3.26: Trajectory of ALTIFLOAT drifters released August 27, 2013 around 13:00 (data acquired OGS)

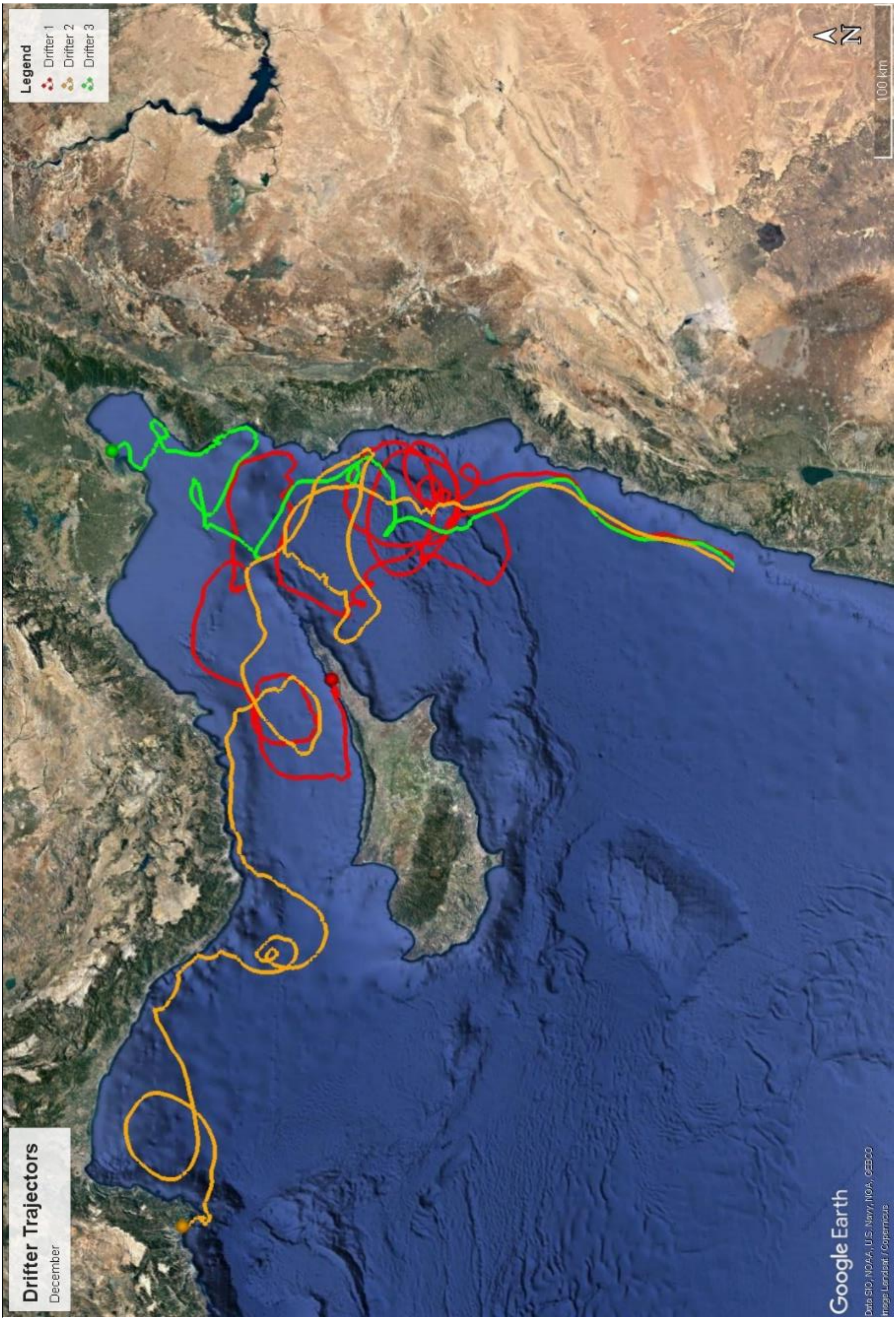

Figure 3.27: Trajectory of ALTIFLOAT drifters released December 17, 2013 around 13:00 (data acquired from OGS)

These patterns are more clearly depicted above, in the 2013-2014 campaign by the Envi-Med Regional Programme, organised by the Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS). Iridium drifters were deployed off the southern coast of Lebanon near Tyre to better understand currents in the eastern Mediterranean. The results of the nine buoys are presented in the above figures. The flows suggested by their trajectories do indeed indicate a weak current, most consistent in Summer (see Figure 3.26). The buoy reached the shores of south-eastern Turkey about one month after initial release from near Tyre. The others remained close to the coast, projecting northwards and ending in northern Lebanon and near Tartus, Syria. Flow patterns are clearly much more erratic in Winter, as depicted in Figure 3.27, mirroring wind directionality and strength at this time. In Spring, one of the drifters remained in place, with two proceeding northward after brief dips south and west.

3.3 An Intertwined System

Based on the analysed data, the Levantine coast and Lebanese hinterland can be divided into several environmental zones (EZ) based on climate and topography. The first is roughly from Seleucia to Tyre, a narrow coastal strip characterised by flat lands and annual precipitation of around 600-800 mm/year, with specific pockets receiving up to 900 mm/year. These coastal lands are composed of mollisols and inceptisols in Syria, and primarily entisols in Lebanon, forming a relatively fertile and cultivatable terrain (A.2). Temperatures range from an average of 6°C in the Winter to roughly 26°C in the Summer, and agriculture is prevalent, especially in south Lebanon and the coastal part of Syria near Seleucia Pieria. Further south, a second environmental zone can be differentiated at the coastal region near Haifa, which is characterised by Mediterranean Red Soils, suitable for cultivation, which extends south to Jaffa. The climate is comparable to the central and northern Levant, with slightly higher temperatures and lower rainfall (roughly 500-600 mm/year). South of this region, a third coastal area emerges, running roughly from Jaffa to the southern-most tip of the Levant. Yearly precipitation averages between 200-400 mm/year, and the temperature ranges from 12-15 °C in the Winter to 28 °C in the summers. Soils are generally cultivatable, but require maintenance and irrigation.

The fourth environmental zone is that of the Mount Lebanon Range and Syrian Coastal Mountain Range, the former extending roughly from the hinterland of Tyre in the south to Nahr el Kebir in the north, and the latter running from just north of the Homs Gap into Turkey. Although the Homs pass north of Syria separates the Mount Lebanon Range and the Syrian Coastal Range, due to the high degree of similarity between the environments of each range, they have been grouped as a single entity. Temperatures range from 3-6°C in the Winter to 20-26 °C in the Summer, with yearly precipitation ranging between 800-1000 mm/year, with certain peaks such as Bikfaya and El Arez receiving up to 1600 mm/year. This area is covered in terric anthrosols and lithic leptisols, generally suitable for growing fruit trees and grazing. This region appears to be well-suited for olive trees and grapes through terracing and upkeep. Apart from the highest peaks, which receive snowfall in the Winter (Aouad-Rizk et al. 2009), the mountains are well-watered and generally do not require irrigation for olive and grape cultivation.

East of this zone is the Bekaa Plain, which can be divided into a southern and northern region (EZ 5 and EZ 6). The southern region (EZ 5) receives roughly 600-800 mm/year of precipitation with temperatures ranging between 6-8 °C in the Winter to roughly 24 °C in the Summer with intense humidity. The area is covered in eutric cambisols, a highly cultivatable soil that is well-suited for all types of agriculture. The north-eastern region (EZ 6) near Hermel can be differentiated based on precipitation, as this region is much drier (roughly 200 mm/year) and requires irrigation for agriculture. These areas are more suited to the agriculture of grains and cereals, which require wide, flat fields. Orchards flourish primarily in EZ 5, similar to EZ 4, as attested by the various citrus groves and vineyards that dominate the landscape today.

In terms of maritime connectivity, the rocky mountains that run adjacent and parallel to the Levantine coast appear to have been quite influential in the development and continued use of various harbours and anchorages. Specifically, the coastal stretch (Zones 1-3) is extremely narrow throughout, making large-scale settlement difficult. However, small pockets characterised by wider plains generally allowed for the growth of larger urban centres throughout history (i.e. Caesarea, Akko, Tyre, Sidon, Beirut, Tripoli, Seleucia; discussed in Chapter 7). Those that benefitted from natural shelter from the dominant winds and wave action also developed active ports to support the site's population, especially given the rarity of well-sheltered sites (with the exception of Caesarea).

General maritime patterns indicate a prevalence of south to north movement (3.2.1); however, daily and seasonal variations, as well as the choice of departure and arrival points, suggest a number of possible connections that might diverge from this trend (Blue 1995: Chapter 6). One important route, especially in the context of this thesis, seems to connect Beirut with Cyprus, though the patterns are dynamic and shift throughout the day of every season. Departing from Cyprus towards Beirut is most ideal in Autumn, on Spring afternoons, and anytime in Summer. From Beirut to Cyprus, Spring mornings were the best period for sailing (also benefitting from the nocturnal offshore land breeze), and this journey was also possible in Winter (Blue 1995: Chapter 6). Thus, this suggests that the ideal sailing period for ancient merchants travelling between Beirut and Cyprus was from Spring to Autumn, coinciding with the coming of the Etesian winds. Otherwise, movement through the port of Beirut is generally directed northwards, with southern movement aided by a shift in the wind on Spring mornings (Safadi 2016: 354-6). While movement south throughout the year was possible, it required the exploitation of diurnal winds and opportunistic meteorological fluctuations, and likely involved the frequent utilisation of transit anchorages (Blue 1995: 6.2.7.1-2).

Figure 3.28: Climatic zones based on soil composition, annual precipitation, temperature, and topography

3.4 Conclusion

The patterns highlighted in this section did not necessarily dictate production trends or commercial routes in Roman Beirut or the Levantine coast as a whole, and should not be taken as direct causal variables. However, clear trends emerge from the data when considered in context with grape and olive cultivation, as well as a seamless consideration of terrestrial and maritime landscapes. The topography, climate, ecology and maritime environment of Beirut and its environs lay the foundation with which to characterise the data presented in later chapters. This provides a more comprehensive understanding of *Berytus* in its context as a port city, and as a centre of exchange for a wider land and marine space. Thus, to sum up, perhaps Beirut and other ports, cities, towns and even villages are, in some sense, reflections of larger, ecological processes (Horden and Purcell 2000: 90).

Chapter 4 **Approaches and Methodology**

> *The survey researcher who discusses is not wrong to do so. Rather, the researcher is wrong if he or she fails to acknowledge the theoretical basis on which it is meaningful to make measurements of such entities and to do so with survey questions.*
>
> - **Kirk and Miller 1986: 15**

Having outlined the main research questions presented in this work, discussed the relevant literature and assessed the study region, what is the most appropriate way to test the hypotheses presented in this thesis within the environmental context of the Roman Near East? Furthermore, how should the data be quantified, analysed and interpreted? The approach taken both in statistical quantification and analysis, as well as in the interpretation of results, affects the conclusions drawn, the 'reliability' of these conclusions, and their qualitative application (Gelman and Hennig 2017: 23-4). As discussed earlier, some of the themes of this dissertation are quite broad and explore complex topics ranging from economic principles, to ceramic quantification and analysis at multiple sites, to the dynamics of ports and port systems. Thus, before presenting and assessing the data, it is necessary to outline the methodological approach taken in acquiring and processing this information. This chapter is organised according to various scales of focus, beginning with the micro before proceeding to larger theoretical approaches. I start with the methodology involved in ceramic quantification (4.1), followed by a brief consideration of the approach taken in assessing the port of *Berytus* as a hub of distribution (4.2), the potential export targets in the region (4.3), and finish with the broader network analytical approach (4.4).

4.1 **Amphorae: Quantitative Analysis and Interpretation**

In this thesis, amphorae are used as the primary line of evidence with which to examine commercial routes in the Roman Levant. An amphora is a pottery container utilised for the non-local transportation primarily of agricultural products, but also other various foodstuffs (Hayes 1997; Keay and Williams 2014). It was possibly initially utilised for transporting agricultural produce in the northern Levant as far back as the 15th century BC, and became increasingly common during the early-first millennium BC (Peacock and Williams 1986: 20). Its use became more widespread and eventually, it became the standard vessel for the maritime transportation of a variety of products, primarily olive oil, wine and fish sauce (Hayes 1997: 27; Peacock and Williams 1986: 1). Thus, while ceramic vessels are often analysed as archaeological objects in themselves, amphorae are unique in the sense that they represent an economic transaction. This allows them to be utilised as an index of economic activity and seaborne distribution (Keay and

Williams 2014). When quantified on a larger scale, they can be used as a reflection of commercial trends in the long run (Bowman and Wilson 2009: 17).

Today, hundreds of different types of amphorae have been identified throughout the Mediterranean and beyond (Hayes 1997: 28; Keay and Williams 2014). Over the past several decades, archaeologists have established extensive typologies for various regions around the Mediterranean that characterise families of vessels according to size, fabric, shape and other features (Keay 1984). This allows for subsequent identifications in survey and excavation to be made more rapidly and with more precision. Some vessels were also stamped, which provides valuable information regarding their production (Hayes 1997: 28). At times, amphorae were also inscribed at some point in their transportation, shedding light on the involvement of individuals and places in their production and transport (Peacock and Williams 1986: 9-14). Thus, amphorae are key pieces of evidence in characterising the industries of the commercial, commonly-used products they contained at a number of points in the distribution process.

Naturally, the quantification of amphorae plays a large role in subsequent analyses and resulting conclusions. This process involves two main steps: the quantification of the ceramic vessels themselves (Tomber 1988), and the conversion of this number into an estimated volume of various products (De Sena 2005; Marzano 2013: 93-4; Peña 2007: 199). The former can be further differentiated into two parts: a raw count of the number of ceramic sherds, with various ways of determining vessel equivalents (Baxter and Cool 1995; Bellanger and Husi 2006; Orton 1989), and the subsequent sorting of these sherds based on characteristics and typologies (Majcherek 1995; Peña 2007: 24-6). An estimation of total volume of an assemblage combines a consideration of the capacity of specific vessels with the raw quantification of sherds (which must subsequently be converted to a figure representative of the number of vessels) (Bellanger and Husi 2006: 170-1) to provide overall estimates of the levels of imports or exports of various products (Peña 2007: 303; Rodríguez Almeida 1984: 116-9). Given the lack of consensus regarding the true volume of the Beirut Type (Reynolds 1999: 50) and the fragmentary nature of the data (as will be seen in later chapters), along with the notorious subjectivity involved in such macro estimates with numerous assumptions (Hobson 2012: 176; Hopkins 1980: 103-4), the conversion of ceramic data into an estimate of the volume of product transported is not feasible in this thesis. Therefore, I have focused on the quantification of the ceramic vessels themselves to serve as a preliminary proxy for commercial trends.

4.1.1 Sherd Count

The basic measures utilised by ceramicists in most analyses are sherd count and weight (Hayes 1996: 147-8; Reynolds 2000a; Taylor et al. 1997). While some reports will include all types of ceramic sherds (Rice 2011: 85), this is usually primarily focused on diagnostic sherds, composed of rims, bases and handles, as well as any sort of slipped or painted sherd that allows for an identification of what ceramic vessel that sherd came from (Fletcher 2008: 113; Orton 1989: 96). However, the nature of the term 'diagnostic' is quite subjective, and is often criticised due to the variability in which sherds can actually provide a reliable identification (Peacock 1977: 261). This issue is quite prevalent in the excavation or survey phase of a study, since archaeologists focused primarily on the collection of diagnostic sherds (based on the definition provided above) will often omit non-painted body sherds that might actually be diagnostic (Gregory 2004: 27).

For this reason, it must be stated that there are two levels of bias involved in the quantification of a ceramic assemblage utilising a raw sherd count. Firstly, an uncovered assemblage does not necessarily represent the entire population of discarded amphorae on a site. In most cases, the assumption is that the sample size taken is large enough that it can be taken as reflective of the whole population (Orton 1989: 96). Secondly, if archaeologists are collecting and processing only diagnostic sherds, the omission of body sherds in itself represents a significant level of bias in data collection (Leidwanger 2013b: 188; Peña 2007: 344). Thus, the sample provided in most ceramic analyses is essentially a fraction of a fraction of the 'true' quantity of amphorae produced and utilised on a specific site (Mateo Corredor and Molina Vidal 2016: 334).

Despite these issues and limitations in ceramic analysis generally, sherd count remains probably the most popular method in quantifying assemblages. Weight can sometimes be used as a complement to the measure, and provides some reference as to the nature of an assemblage (two assemblages with equivalent sherd counts but different weights might be reflective of the difference between each sample in the types of vessels present, or breakage patterns for specific types) (Hayes 1991; 1996; Mateo Corredor and Molina Vidal 2016: 2; Tomber 1993: 50). However, since most of the reports utilised in this study do not include weight as a measurement, I have prioritised sherd count as the primary index for ceramic quantification.

4.1.2 Estimated Vessel Equivalents and Minimum Number of Individuals

These measures can sometimes be converted into more complex variables: Estimated Vessel Equivalents (EVE) and Minimum Number of Individuals (MNI) (Bellanger and Husi 2006: 170-1; Mateo Corredor and Molina Vidal 2016). The EVE technique assumes that any ceramic fragment is considered as a fraction of a vessel, which is usually only possible for specific parts, such as rims and bases (Bellanger and Husi 2006: 170; Orton 1989: 96). The measure helps specify how much of a vessel is actually represented by a specific sherd. In calculating the MNI, it is assumed that fragments belong to the same vessel unless they can be shown to belong to different ones (Bellanger and Husi 2006: 170). Providing such a variable can be quite valuable, especially since the primary goal in this work is to trace the frequency of the Beirut Type, specifically the quantity of vessels at various sites, and calculate the percentage of the total assemblage of amphorae it represents. Unfortunately, unless these factors are provided in ceramic analysis reports, or detailed measurements are given, they require direct access and examination of the uncovered assemblage (measurement of ribs/bases for EVE and differentiation of diagnostics for MNI) (Baxter and Cool 1995: 94). For this reason, I refrain from using them in statistical analysis.

4.1.3 **Typology and Sorting**

After collection and initial quantification of a ceramic assemblage, this characterisation is usually further refined according to existing typologies to specify the source, fabric and time period of production of each amphora. Arguably the most basic form of sorting in ceramics is the binary observation of a specific type of vessel being present or absent (Bellanger and Husi 2006: 170; 2012: 779; Orton 1989: 94). This tool is useful in tracing the range of a distribution of a specific type of amphora, but lacks the quantitative information that would allow for analysis of its frequency at certain sites (Rice 2011: 81). In the absence of quantifiable data, marking the presence or absence of specific types of vessels at least allows an initial characterisation of the types of material arriving at each site. As seen in Figure 4.1, the technique not only establishes the extent of a network based on ceramic distributions, but also can help to quickly and simply highlight areas with a lack of fieldwork or publication. For example, at the time of Peacock's publication, ceramic reports for Roman sites in the Levant and Cyprus were lacking. However, as has been shown in recent work (Johnson 2008a; Kaldeli 2013b: 126; Patrich 2011; 122; Reynolds 2000a), a number of different types of African amphorae were actually reaching eastern Mediterranean sites, both maritime and terrestrial.

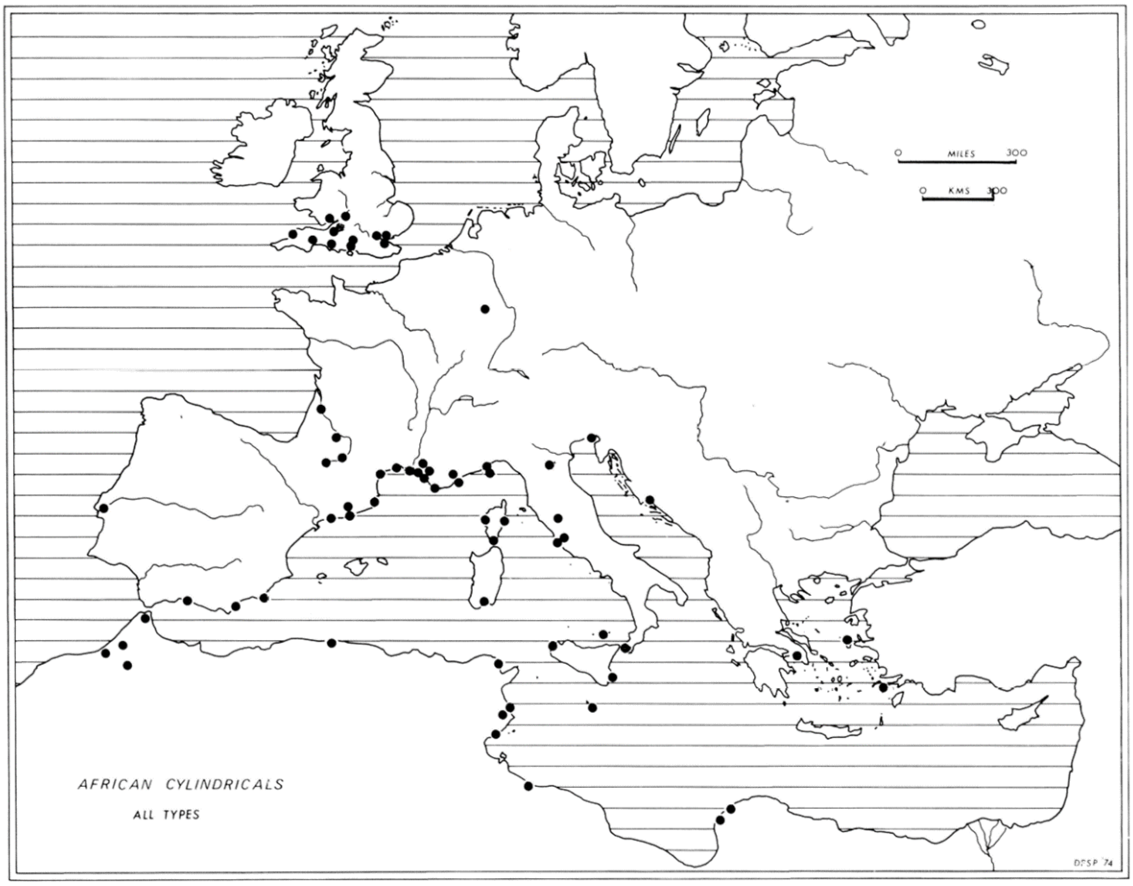

Figure 4.1: Distribution map of African amphorae based on presence/absence technique (after Peacock 1977: 278, Fig. 6)

The matter is further complicated by the context of finds, especially in determining the vessel's production, primary use, re-use and discarding (Peña 2007: 6, 119-21). For example, an amphora sherd uncovered from a kiln waster should be regarded as different from one found in a wealthy, residential building, or as part of a shipwreck cargo (Keay 1984: 133; Leidwanger 2017). Such factors should be considered in any ceramic analysis, and its subsequent application to commercial routes and economic trends. This involves a differentiation of scales of focus, and a specification of an amphora type's presence or absence in various contexts (Peña 2007: 344). This clarification is particularly important for a site such as Jiyeh, which is characterised by a residential area and a workshop (Wicenciak 2016b). The presence of an amphora sherd in each context represents quite different types of use and 'behavioural practices that governed the formation of the Roman pottery record' (Peña 2007: 352).

Determining the frequencies of various types of amphorae within an assemblage can be done through a number of methods, with the most common strategy utilising a raw count of diagnostic sherds, and a calculation of the representative percentage of the assemblage as a whole (Orton 1989: 96). This can also be conducted utilising representative weight (Hayes 1996; Tomber 1993) or measurements such a EVE or MNI (see above). The organisation of this data is quite relevant, since scholars sometimes prioritise fabric (Reynolds 1999; 2005), general source (Kaldeli 2013a; 2013b), typologies (Peña 2007: 121, 129), product (De Sena 2005), or some combination of these variables (Keay 1984; Keay and Williams 2014). Each variable provides a different kind of information, with source, destination and product often proving most relevant in discussions of commercial patterns (Parker 2008). As a result, archaeologists generally strive to arrive at quantified data that is organised according to these variables.

This aspect of sorting is quite subjective, given the inherent reliance on previous typologies and the assumption that their established sources and dates are correct (Majcherek 1995: 163). A good example of this issue is in the characterisation of the Late Roman Amphora 1 (LRA 1), which is a term utilised to specify an amphora type with a diverse range of sub-types (Keay and Williams 2014). This complexity reflects the presence of numerous production sites in Cyprus, *Cilicia*, and possibly Syria with different fabric types (Demesticha and Michaelides 2001; Empereur and Picon 1989; Reynolds 2005; Vokaer 2013: 570). Thus, the generalisation of numerous vessels representing different sub-types and sources as LRA 1 can result in misrepresentations of frequencies sorted according to origin. Regardless, with definitive identifications of amphora kilns and workshops, and the correlation of these sites with a distinct fabric, sourcing can be conducted with more reliability.

4.1.4 **Methodological Approach**

Developing the methodological approach for ceramic analysis in this thesis was difficult, as there is a significant level of variance between published reports in the eastern Mediterranean. In some cases, authors provide photographs, specific date ranges and provenances, and in-depth statistical analysis (Meyza and Bagińska 2013; Johnson 2008a; Kaldeli 2013b; Reynolds 1999; 2000b). However, some reports focus primarily on special finds and lack detailed statistics (Berdowski 2006; Hughes 2010; Tsori 1977). Likewise, certain reports provide overall sorted counts (Tomber 1999), while others list each amphora without any comprehensive quantification (Winther Jacobsen 2005). Furthermore, there is a lack of standardisation in the terminology utilised to describe specific amphora types. The Almagro 54 amphora type, for example, is also referred to as LRA 4, Keay 54, Kuzmanov 14, Peacock and Williams 48 and 49, and Zemer 53 (Keay and Williams 2014). This problem is intensified for the Beirut Type, given the frequent use of the term 'carrot-type' as a descriptive feature for a number of Levantine forms (Carreras and Williams 2002; Kaldeli 2013b: 371-2; Reynolds et al. 2010). As will be seen, some of these include products of Beirut, but not those forms specifically labelled 'carrot-type' amphorae from Beirut (Gendelman 2012: 35). The term 'carrot' is used as a description for body shape, a general tradition for Levantine ceramic production, as well as for a specific amphora type produced in Beirut. Unsurprisingly, this can cause some confusion, especially when assessing a wide range of ceramic reports that have been compiled over several decades.

Based on the abovementioned difficulties, I have taken several steps in an attempt to standardise the data utilised in this report, utilising a consistent methodology to compare assemblages across sites. Firstly, regarding the issue of certain reports focusing on particular finds, I have elected to only include assemblages taken comprehensively from specific contexts. Secondly, given the discrepancy between the various measures utilised in each report, I have utilised raw sherd count as the primary index of quantification. The reports included in this study focus on diagnostics (ribs, bases and handles mostly; sometimes a painted or glazed piece), but include a comprehensive assemblage (local and foreign types). The exception is the ceramic report for Ashkelon, which only provides quantifiable data for imports in the Roman period; as a result, the frequencies provided are a percentage of total imports, as opposed to a percentage of the entire assemblage. Thirdly, due to the issues involved in typology classification, sourcing, and dating, I have elected to begin with a comprehensive classification that specifies place of production, possible transported product, period of production, and other names used to describe the type (Table 4.1). This information has been acquired largely from the ceramic reports, and substantially supplemented by Keay and Williams's *Roman Amphorae: A Digital Resource*, which is arguably the most comprehensive compilation of all known Roman amphora types (Keay and Williams 2014). In certain cases, particularly in ceramic reports acquired from sites in Cyprus, the listed typologies do not correspond to any widely recognised types; in these cases, I have listed the name provided in the report. Finally, I have also specified the context from which an assemblage was uncovered to differentiate between vessels found at a possible production site, in transit, in storage, or in a phase of consumption. This context is crucial in making the connection between a ceramic vessel and the commercial transaction it represents (Peña 2007: 6).

In sorting this data, the priority is identifying and quantifying the frequency of Beirut Type amphorae. Therefore, the first phase of analysis involves noting the type's presence or absence in each assemblage. This requires a re-examination of all ceramic reports due to the relatively recent recognition of the Beirut Type as a distinct product of Beirut (Reynolds 1999; 2000b). Since the type was unknown prior to the late-1990's, and not widely recognised to this day, ceramicists have usually grouped it under the general term 'Eastern Mediterranean', mistakenly attributed it to another eastern Mediterranean source, or simply as Lebanese (Adan-Bayewitz 1986; Silberstein et al. 2017). For this reason, I have chosen to re-examine all ceramic reports, and not only those which were compiled prior to 2000.

Amphora Type	*Sherds (diagnostics)*	*% of total sherds*	*MNI*	*% of total MNI*	*Product*	*Date*	*Other Names*	*Source*	*Reference*	*Notes*

Table 4.1: Template used in the organisation of amphora data; full tables presented in 0

Lastly, I have calculated several rates of frequency, characterised by source and typology, to help shed light on commercial trends involving *Berytus*. The resulting numbers are subsequently utilised to perform various statistical analyses to explore degrees of correlation between products of Roman Beirut and those of various sources throughout the Mediterranean collected at the analysed port sites.

4.2 Methodological Considerations: The Port of *Berytus*

As this dissertation serves to better understand maritime commercial connections in the Levant within which Beirut was involved, it is necessary to outline the development of the port that facilitated such networks. This comprehensive characterisation of the Roman port city has not yet been undertaken beyond site-specific reports with in-depth analysis only for certain contexts (Elayi and Sayegh 1998; 2000; Thorpe et al. 1998). Therefore, there is a need for a holistic examination that incorporates independent publications by the many individual teams that worked in the city. This work is presented in Chapter 5, and utilises published material regarding maritime installations in use in the Roman period, geomorphological surveys that help in tracing the harbour's evolution over time, and general outlines of the city to shed light on the urban centre. Additionally, ceramic analyses conducted for the material found in Beirut are utilised to assess the degree of commercial reciprocity in distributions between *Berytus* and other Roman ports in the eastern Mediterranean. This is undertaken through statistical tests of correlation and regression analysis in Chapter 8.

Additionally, to shed light on the production of wine and potentially olive oil packaged in the Beirut Type, Chapter 6 details rural settlement and production sites of wine and olive oil within the territory of *Berytus*. This is conducted by establishing the most prevalent terrestrial routes that connect the urban centre of *Berytus* with its hinterland, and comparing this proposition to the location of Roman sites in the highlands east of Beirut, as well as in the Bekaa. This has been done through least-cost route analysis in ArcMap using the Cost Path Tool. The point of origin for the first output was taken from the urban centre of Beirut. A Cost Distance Raster and a Cost Back Link were then established based on a slope map of the region, which identify the least accumulative cost distance over a cost surface, and the most efficient directionality of each cell in the raster, respectively. From this data, it is possible to propose the most efficient route from

Beirut through the Mount Lebanon Range. These routes can then be compared to the actual distribution of Roman sites in Beirut's hinterland to assess the prevalence of this route, the prioritisation of other paths, or highlight gaps in the data. Subsequently, the productive capacity of the colony is determined through the compilation of distribution maps of wine and oil presses in the region. Essentially, these inquiries shed light on the port city and its development over time, and contextualise these insights within the wider terrestrial region.

4.3 Commercial Networks in the Eastern Mediterranean

Having discussed the primary lines of evidence utilised in this thesis, and briefly touched on the focal point of the potential commercial network (Beirut itself), I now detail the criteria of sites included in the chosen sample for analysis. Essentially, the sample consists of port sites along the Levantine coast and Cyprus; the commercial patterns between these sites are then determined based on an analysis of all amphora frequencies observed at each site. This has been undertaken with a particular focus on the distribution of the Beirut Type, to assess the frequency of exports from Roman Beirut, and compare these observations with wider regional trends. As this thesis primarily concerns itself with maritime routes and commerce, and no quantitative assessment of the Beirut Type's distribution has yet been conducted, the emphasis is on all regional port sites to give a much-needed overview. Since amphorae were primarily transported through fluvial and maritime transportation (Keay and Williams 2014), this focused assessment sheds light on the extent of distributions in the regional market. But what, then, constitutes a Roman port, and how should the selection of sites be organised methodologically?

4.3.1 Site Choice

Regarding the definition of a port site, arriving at a singular classification is quite difficult given the wide variety of maritime sites throughout the Mediterranean (Leidwanger 2013d: 222). In categorisation, some scholars focus on physical maritime installations (Oleson 1988; Rickman 1988), some on the size of the harbour (Blackman 1988a: 3), while others prioritise the commercial function of the site over architectural remains as a prerequisite for consideration as a port (Leidwanger 2014). Ultimately, based on an assessment of recent scholarship discussing Roman ports, it seems that the current consensus centres on a combination of the abovementioned factors as part of what defines a port city (Hurst 2010; Keay 212: 33, 56-7; Khalil 2010; Uggeri 2006).

This study focuses on what can be defined as a commercial port, to be differentiated from smaller, private ports and 'opportunistic ports' (see Chapter 2). A private port is defined here as a smaller harbour, either naturally sheltered or supplemented with artificial installations, that is dedicated solely to one or several private actors (Marzano 2007: 41-2). In the Levant, only one *villa maritima* (villa usually with a private harbour) has been identified along the Levantine coast at Ashkelon (Roll and Tal 2008: 136), and it has not been associated directly with a private harbour space. All other coastal villas seem to have been located some distance away from the coast (Stern 1995; Thorpe et al. 2001; Tsuf 2018: 197), though this does not eliminate the possibility that they utilised a coastal space outside the urban port centre for loading and unloading vessels (Leidwanger 2014). Thus, this type of maritime centre is not the most appropriate for the purposes of this thesis.

An opportunistic port is any maritime anchorage or landing spot that might have been utilised for shelter in transit, or to serve a small community (Leidwanger 2011). As mentioned in Chapter 2, such sites are difficult to see in the archaeological record, and fairly malleable in terms of their defining characteristics (Leidwanger 2020: 165-6). They might be suggested by maritime environmental factors such as coastal accessibility and shelter from dominant winds and swell (Blue 1995: Chapter 4). However, given that such sites are not often characterised by a high density of archaeological material, or permanent structures and facilities (Leidwanger 2013d: 223-4), they are not as useful in tracing economic patterns specifically through quantifying amphora frequencies.

A commercial port is a harbour with functional aspects – physical and organisational – related to commerce, administration and wider terrestrial networks (Keay and Boetto 2010: 3; Rickman 1988: 257-68). In this way, three key differentiations can be made between commercial ports and non-commercial ports. Firstly, a commercial port is characterised by some sort of administrational structure that might impose tariffs or taxation, regulate maritime traffic, or facilitate the loading and unloading of products (see next paragraph), while private and opportunistic ports did not fall under similar jurisdiction. Secondly, a commercial port is generally larger in size and capacity, and experiences a higher degree of traffic with its hinterland as well as with other ports (Wilson et al. 2012). This proposition is made cautiously, as an opportunistic port might lie in a geographically and socio-politically strategic position on the micro-scale, and, as such, be a frequent stop for ships acting within a regional market (Blue 1995: Chapter 6). However, it is less well-connected on a wider scale, especially in comparison to urban ports that were recognised throughout the Mediterranean. For example, an opportunistic port along the Levantine coast was probably less visited by merchants arriving from the western Mediterranean than Caesarea or Paphos (as seen in the frequent western amphorae observed in D.1.6 and D.1.11) (Leidwanger 2020: 84). Thirdly, a commercial port is characterised by permanent structures and situated within or associated with an urban centre (Arnaud 2016: 165-6; Raban and Galili 1985).

For a more refined definition, four main criteria have been outlined to warrant a port site's inclusion in the study: a quay or docking area, whether characterised by artificial harbour installations or provided naturally by the maritime environment (Carayon et al. 2011: 45-6; Galili and Sharvit 2000: 85; Oleson 1988: 147-8; Stager et al. 2008; Stock et al. 2013); storage space related to the deposition and holding of various imported goods or those intended for export (Aubert 2016: 623; Hurst 2010: 57-60; Stabler et al. 2009: 1; Wilson 2007: 179); administrational structure involved in buying, selling, packaging and processing goods for shipment or import (Keay 2016: 292-3, 304; Leidwanger 2013d: 234; Rathbone 2003; Wilson et al. 2012); and an intertwined network with the regional hinterland, for facilitating the sale and distribution of local rural products, as well as importing goods for consumption (Blue 2002: 142; Cioffi 2016; Keay 2012: 33; Pieri et al. 2011: 264; Raepsaet 2016: 849). This sample can be further refined based on each site's capacity (Rickman 1988: 257-8). However, this is difficult to quantify, since there are a variety of ways to measure the capacity of a port such as using the physical capacity of the harbour (Hurst 2010; Hurst and Stager 1978: 341-2; Raban 1989: 288) or the capacity of the port's hinterland (Broekaert and Zuiderhoek 2020: 101-7; Keay 2016: 291). For this reason, in this thesis, the abovementioned criteria were prioritised over physical measures such as harbour basin size, quay space or water depth, though these factors are discussed briefly in Chapter 5 and Chapter 9.

The use of the term commercial port is not to suggest that opportunistic or private ports did not engage in commerce. In fact, they often did, and were tied closely to the main regional maritime sites (Keay 2012). In certain cases, they even had storerooms adjacent to the harbour (Marzano 2007: 435) and were located strategically along a river and possibly close to kiln sites to facilitate the packaging and loading of agricultural products in amphorae (Reynolds 1999). Furthermore, private ports could reach immense sizes, as attested at the Torre Astura *villa maritima*, with a harbour measuring approximately 78,000 m^2 (Marzano 2007: 49, Fig. 5; Wilson et al. 2012: 381). However, the infrastructure behind their function differs from that of commercial ports, in addition to the fact that they are generally smaller in size (Marzano 2007: 41).

4.3.2 **The Spatial Classification of Sites**

Based on these criteria, 21 port sites from Cyprus and the Levant were selected for inclusion in the assessment of the Beirut Type's regional distribution (Table 4.2). These sites have been organised in two scalar foci: one at the site-specific level, which groups each port site with its surrounding hinterland, and another at the regional level, which groups port sites together as part of a province. The former serves to assess a port system in its terrestrial context, and provide a preliminary assessment of the penetration of imported amphorae in the hinterland. This consideration sheds light on the nature of this transaction, specifically of whether the amphora was still in transit, being stored, or being redistributed for local consumption (Arnaud 2016; Peña 2007: 7; Schiffer 1972: 157; 1996: 4). Therefore, when possible, ceramic reports of rural sites with some socio-economic tie to the sampled port cities were also reviewed in cases where the Beirut Type was uncovered at the port site.

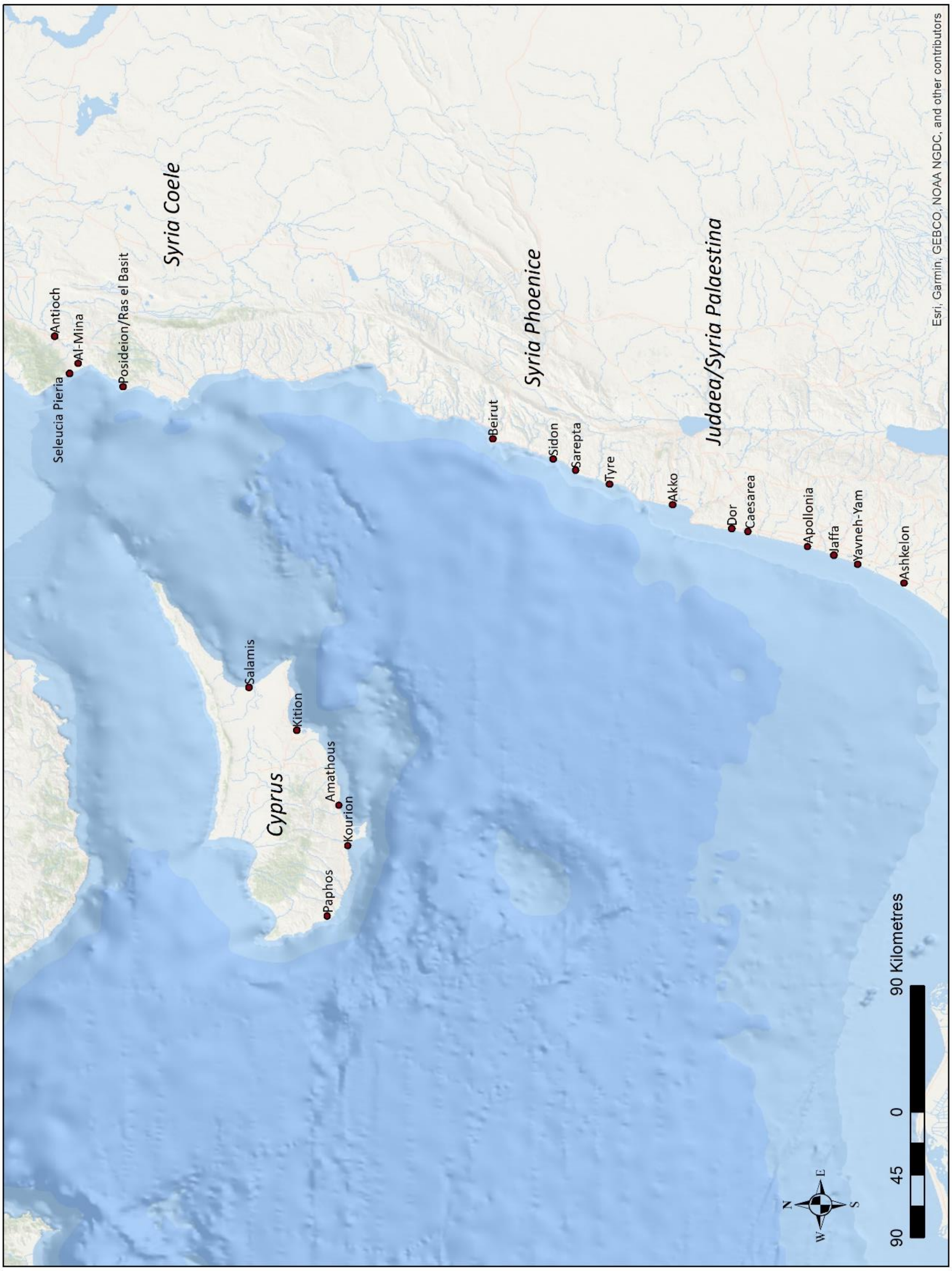

Figure 4.2: Port sites included in the study, depicting the discrepancy between the state of research in the southern Levant and northern Levant

Site	Modern Country	Roman Province (2nd BC-1st AD)	Roman Province (1st AD-2nd AD)	Roman Province (2nd AD-4th AD)	Usable Data	Notes	Included
Amathous	Cyprus	Cyprus	Cyprus	Cyprus	Yes	Minimum area calculated from quay measurements; Empereur 1987b	Yes
Kition	Cyprus	Cyprus	Cyprus	Cyprus	No	No quantifiable data available, but included in presence/absence compilation	P/A, not stat. analysis
Kourion	Cyprus	Cyprus	Cyprus	Cyprus	Yes	Leidwanger 2020	Yes
Paphos	Cyprus	Cyprus	Cyprus	Cyprus	Yes	Miszk and Papuci-Władyka 2016	Yes
Salamis	Cyprus	Cyprus	Cyprus	Cyprus	Yes		Yes
Akko	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Galili, Rosen, Stern et al. 2007	Yes
Anthedon (Anthedonius Portus)	Israel	Judaea	Syria Palaestina	Syria Palaestina	No		No
Apollonia	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Galili et al. 1993	Yes
Ashkelon	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Stager and Schloen 2008: 9	Yes
Caesarea	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Brandon 1996; Raban 1989	Yes
Dor	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Quantification difficult, contexts are intertwined in reports, and heavy focus on pre-Roman periods; Roman harbour installations not well-understood	P/A, not stat. analysis
Jaffa	Israel	Judaea	Syria Palaestina	Syria Palaestina	No	Burke et al. 2017	Yes
Yavneh-Yam	Israel	Judaea	Syria Palaestina	Syria Palaestina	Yes	Galili et al. 1993: 62, Fig. 2	P/A, not stat. analysis
Beirut	Lebanon	Syria	Syria Coele	Syria Phoenice	Yes		Yes
Sarepta	Lebanon	Syria	Syria Coele	Syria Phoenice	?	Unpublished ceramic reports on Roman material; Pritchard 1978	No
Sidon	Lebanon	Syria	Syria Coele	Syria Phoenice	Yes	Limited ceramic reports; area likely underestimation; Marriner et al. 2006	Yes
Tyre	Lebanon	Syria	Syria Coele	Syria Phoenice	Yes	Limited ceramic reports; Marriner and Morhange 2006	Yes
Al-Mina	Syria	Syria	Syria Coele	Syria Coele	SURV		P/A, not stat. analysis
Antioch	Syria	Syria	Syria Coele	Syria Coele	Yes	Fragmentary data, not reliable enough for detailed analysis, but preliminary assessment given based on photographs	Yes

Posideion/Ras el Bassit	Syria	Syria	Syria Coele	Syria Coele	SURV	Older excavations closer to coast, recent excavations focused on later periods farther inland; large bay, but ancient installations fragmentary, extent unknown; Blue 1995; Carayon 2008	P/A, not stat. analysis
Seleucia Pieria	Syria	Syria	Syria Coele	Syria Coele	SURV		Yes

Table 4.2: The port sites of the Roman Levant chosen for consideration, further refined based on ceramic publications

At the regional level, port sites have been grouped according to Roman provincial divisions, specifically *Cyprus*, *Syria Coele* (northern coastal Syria), *Syria Coele/Syria Phoenice* (the central Levantine coast, which was separated from Syria Coele as a distinct province in the late-2nd or early-3rd century AD – Hall 2001-2002: 149-51) and *Judaea/Syria Palaestina* (originally Judaea, reorganised as the province Syria Palaestina sometime around 135 AD – Cassius Dio 69.13; Butcher 2003: 84; Millar 1993: 374). This organisation serves to assess the prevalence of provincial divisions on the maritime commercial patterns of Beirut (or lack thereof). In other words, after compiling the data, contextualising it based on environmental factors, and performing statistical analysis, this grouping allows another form of consistent categorisation based on socio-political divisions.

4.3.3 **Strengths and Limitations of the Database**

The focus on commercial ports (as opposed to maritime sites of all sizes and economic capacity) serves to narrow an overwhelming potential pool of data to a selection of comparable sites. This is crucial for the appropriate application of network analysis, since the differentiation between nodes (in this case, ports) in a network occurs in the examination of the connection (distribution of the Beirut Type) between sites as opposed to the nodes themselves (Brughmans 2013: 649; Evans et al. 2009; Mitchell 2009: 254). Practically, this means that data at any port site is assumed to be equal to data at any other port site (though this data must be contextualised politically, socially and environmentally). The need for this comparability is more apparent when considering the difference between a commercial port as defined above and a smaller maritime site that might have served the immediate locale, and possibly lacked a defined physical harbour space and administrational structure (Leidwanger 2013; 2014). More specifically, a negative response at a large commercial port such as Paphos or Caesarea carries more weight than one at a transit ‘opportunistic’ site. This is because large sites experienced a higher degree of traffic (Oleson 1988: 148), possibly making them more likely recipients of the Beirut Type. Similarly, the presence of Beirut Type amphorae at a small anchorage connected to the immediate locale might be more significant than its identification at a large port site importing huge quantities from a variety of sources. While it is possible to account for these considerations on a case by case basis, the objective is to examine this data using statistical analyses on wider scales of focus to shed light on maritime networks. However, there is still some degree of bias in the subsequent processing of data, since it can be argued that a small site such as Yavneh-Yam experienced a lesser degree of maritime traffic than Paphos, Caesarea or Seleucia Pieria, though all sites are included in analysis with equal weight.

In theory, the difference between sites could be taken into account on a consistent basis, potentially through a ranking system that organised maritime sites according to capacity, function, legal status, degree of maritime traffic, etc. (Ruegg 1988; Schörle 2011; Wilson et al. 2012: 380). This would also require a similar weighting to the relevance of the Beirut Type's frequency based on a site's 'rank'. However, each additional factor introduced into the model adds to the number of assumptions and makes conclusions increasingly subjective. For these reasons, I have chosen to utilise a smaller pool of data to allow for greater consistency and minimise bias. Furthermore, the prioritisation of a single line of data (the frequency of the Beirut Type) as a way of examining connections provides targeted analysis of an otherwise overwhelmingly complex subject.

This is not to diminish the importance of 'ephemeral' or 'opportunistic' ports in the region (Leidwanger 2004; 2011b; Manning et al. 2000). As the goal of this thesis is not simply to quantify and trace the distribution of the Beirut Type in the region, but also to better understand the infrastructure behind oil and wine production, packaging, and transportation, it is crucial to establish whether there were targeted distributions to larger ports, or if merchants were also unloading product at anchorages that served a smaller, more local population. In fact, it has been suggested that in certain cases, moving products through a less-regulated maritime site may have been favoured in order to avoid taxation (Holleran 2012: 89-90; Leidwanger 2007: 308-11; 2013: 237). Unfortunately, these sites are difficult to see in the archaeological record (Blackman 1982a: 88; Leidwanger 2013d: 223), further obfuscated by the state of research in much of the Levant. Thus, while future work might take such factors into considerations, the strategy employed here is appropriate in providing a general overview of the scope and scale of the distribution of the Beirut Type.

4.4 Network Analysis: Ports and Port Systems

In better understanding this data, the final section of this thesis focuses on drawing connections between *Berytus* and other port sites in Cyprus and along the Levantine coast through network analysis. These examinations can be divided into four main themes that explore the prevalence of geographical distance in the distribution of the Beirut Type, the prevalence of 'well-connectedness' of a port, the correlation between various amphora types, and the level of reciprocity between *Berytus* and each regional port. This section introduces the concepts and explains the theoretical rationale behind their inclusion.

4.4.1 **Closeness: The Prevalence of Geographical Distance**

The first measure essentially addresses the question of geographical distance as a factor in the distribution of commercial products. Generally, scholars exploring commercial networks assume that frequencies of distributions should drop as geographical distance increases, since longer distances presumably are costlier for merchants or investors than shorter, regional transportation (Broekaert and Zuiderhoek 2020: 116; Flueckiger et al. 2019; Kaldeli 2013a; 2013b: 205; Parker 2008: 179-82; Renfrew 1977: 72; Tomber 1993). Based on this logic, only larger vessels would have been economically viable to transport cargoes across long distances (Boetto 2012: 168-70; Rice 2016: 186). However, such characterisations, again, often cite Mediterranean-wide patterns to support these models of large-scale long-distance transport (Scheidel 2011). In this thesis, I argue that such examinations might be more appropriate starting on the regional scale before extrapolating results. Given that the port of *Berytus* appears to have been equipped to receive most types of merchant ships (9.3.1), it is necessary to shed light on the effect that geographical distance had on the frequency of the type. Referencing back to Chapter 2, this measure is a reflection of the relevance of a site's 'closeness' to Beirut geographically to its 'closeness' commercially. The first statistical test undertaken in this thesis, therefore, is a regression that assesses the degree of correlation between the distribution of the Beirut Type and geographical distance. A divergence from the general assumption that frequency should decrease as distance increases may be indicative of another form of rationale, perhaps related to socio-political or cultural factors (Karagiorgou 2001; Royal and Tusa 2012; Utz 2018). More importantly, it might also be reflective that other factors play a bigger part in maritime distributions (Leidwanger 2013c; Safadi 2016; Safadi and Sturt 2019).

This test was conducted using the Regression Tool from the Analysis ToolPak, and the Logistic Regression tool from XLSTAT in Microsoft Excel, with geographical distance as the independent variable. Two forms of the test were conducted, one incorporating the binary presence/absence data of the Beirut Type (XLSTAT) as the dependent variable, and another utilising the frequency data (Analysis ToolPak). The statistical test presents the null hypothesis that 'there exists no relationship between geographical distance and the frequency (or presence) of the Beirut Type', and processes the data to allow either an acceptance of this hypothesis, or its rejection. In this way, the Regression Tool effectively predicts a linear relationship between the frequency of the Beirut Type (or presence/absence data) and geographical distance.

4.4.2 Centrality: The Prevalence of Well-Connectedness

The scale-free approach, though it was developed as a part of complex systems analysis, actually utilises a variable equivalent to the degree centrality measure, a concept discussed in social network analysis. This essentially is the concept that new connections attach preferentially to already well-connected nodes, giving them a high degree of centrality (Albert and Barabàsi 2002). When applied to Beirut's maritime network, this would suggest that recipients of the Beirut Type should be ports that were 'well-connected' in the Roman period. Let us examine the assumptions implicit in this principle:

1. The export of products packaged in the Beirut Type represent a 'new' connection, separate from exports in pre-Roman periods, if the Beirut Type is to be understood as a new amphora form
2. 'Well-connectedness' is a representation of attractiveness as a recipient, observable in the archaeological record through the degree of variety of imports at the site

In this thesis, the first assumption is tested statistically by comparing commercial patterns in the Hellenistic period to those from the Roman period. The question posed through this examination is whether or not commercial connections in the new Roman colony should be taken as independent from previous periods, or if long-standing maritime routes remained prevalent after Roman colonisation (discussed in 8.2). This is especially relevant for Beirut, given the fairly impactful changes that ensued after the settlement of two Roman legions and their families (Perring et al. 2003). The second assumption is tested through the compilation of several statistical indices (average, median, range, and standard deviation of amphora frequencies) that measure the variability of an amphora assemblage. Essentially, the goal is to characterise each sampled port's amphora assemblage based on the range of sources being imported, and compare this measure to the frequency of the Beirut Type. This sheds light on whether Beirut Type amphorae were being distributed to well-connected sites, sites dominated by one or two sources, or whether this factor is irrelevant.

This test was performed using the Regression Tool in Microsoft Excel, utilising the abovementioned indices as independent variables and the frequency of the Beirut Type as the dependent variable. Again, the null hypothesis is that there exists no relationship between these factors and the frequency of the Beirut Type, with the statistical output determining whether the hypothesis must be accepted or rejected (results presented in Appendix F and Appendix G, analysis conducted in 8.1.1.2).

4.4.3 **Correlation Between Amphora Frequencies**

To further refine the factor of degree centrality as defined in the previous section, a statistical analysis of the degree of correlation between the frequency of amphorae from different sources has been undertaken for port sites in Cyprus and the southern Levant with quantifiable data. This examination sheds light on possible commercial trends in cases of high correlation, since a high degree of correlation would indicate that amphorae from certain sources were being imported at a similar rate. Similarly, a high negative degree of correlation suggests that sites importing amphorae from one source generally did not import amphorae from the other. Such a pattern might be explained by a number of factors such as the prevalence of certain maritime routes, a focused commercial connection between specific regions, or other socio-political factors (Kaldeli 2013a; 2013b). For example, a close connection between Beirut and Cyprus is often mentioned, citing the use of Cyprus as a transit stop between Greece and Beirut (Arnaud 2001-2002: 172; Reynolds 1999). The assessment of correlation between amphora types on Cyprus provides a statistical method of shedding light on such propositions quantitatively. Similarly, the environmental patterns presented in Chapter 3 suggest maritime routes based on optimal sailing conditions. By determining the correlation coefficient between amphorae from various sources, it is possible to propose routes based on the archaeological data, and compare them to those suggested by the maritime environment.

This test was conducted using the Correlation Tool from the Analysis ToolPak in Microsoft Excel, which provides a value between 0 and 1 that represents the strength of correlation between two variables. The input variables are the frequencies of amphorae based on source, which are organised based on regional divisions. The test was conducted for every port site with fully-quantifiable data to assess general patterns, along with two based on provincial divisions: one for Cyprus and one for Judaea/Syria Palaestina. Two confidence intervals were specified at 95% and 90% as an indication of a high degree of correlation and a moderate degree of correlation, respectively. Additionally, the Regression Tool was utilised to complement this examination. The tool essentially takes the analysis a step further by specifying how much of an effect any correlation has on the frequency of the Beirut Type. For example, a possible concluding statement might be that for every one per cent increase in the frequency of amphorae from X, the frequency of the Beirut Type will increase/decrease by Y.

4.4.4 **Reciprocity and Directionality**

Lastly, to better characterise the nature of the connections suggested by previous statistical tests, it is necessary to explore the directionality of commerce. Certain commercial relationships between port cities in the Mediterranean appear to have had a large difference in the distribution balance (for example, between Rome and Carthage – Fulford and Peacock 1984; Keay 2010: 17; 2012: 38; also between the southern Levant and numerous sites in the eastern Mediterranean – Berlin 1992; Blakely 1988: 42; 1992; Erlich 2017; Huster 2015; Israel 1995a; 1995b; Johnson 1986; Kogan-Zehavi 1999; Nahshoni 1999; Riley 1975). In these cases, products seem to have been primarily leaving one port and arriving at another. Such a pattern warrants examination, since the imbalance must be accounted for quantitatively in some way. This imbalance is sometimes interpreted as a reflection of large-scale state contracting for the provision of agricultural products (*Dig*. 50.4.5, 50.6.5.6, 50.6.5.8-9; Aldrete and Mattingly 1999: 178; Karagiorgou 2001; Koops 2016; Peña 1998; Rice 2016: 1910), or as an indication of regional specialisation resulting in intensive and extensive growth (Ahmed 2010: 25; Mattingly 1988a; 1988b; Wilson 2002: 6).

However, the first step in shedding light on these factors should be inductively through a focus on archaeological data on a regional scale. Regarding *Berytus*, this is done by comparing the frequencies of imports at Beirut based on their source with the frequency of Beirut Type amphorae at those locations. Any imbalance reflects a lack of commercial reciprocity, and a strong directionality. Conversely, a relatively reciprocal relationship indicates a neutral directionality, and suggests that each port site was importing from the other at a relatively similar rate. This portion of analysis is conducted qualitatively in 8.1.3, since the direct comparison of two sites in this case does not require the use of multivariate statistics.

4.5 **Conclusion**

The methodological approach in this thesis combines multiple lines of evidence and various scales of focus to shed light on economic patterns within the colony of *Berytus*. This is done by assessing the port itself (Chapter 5), providing a glimpse into the productive capacity of the hinterland (Chapter 6), tracing the distribution of the ceramic container used to package this product (Chapter 7) and applying network analysis tools in understanding the commercial routes (Chapter 8). In this way, this thesis represents the first comprehensive look at the economic systems of Beirut at various stages in the supply chain, and contextualises them environmentally, politically and socially. Furthermore, the focus on the regional market (within 200 nautical miles from Beirut) allows for a comparison to other regional systems (for example, the wine industry of the southern Levant characterised by Almagro 54 and LRA 5/6 containers; Keay and Williams 2014), as well as with Mediterranean-wide patterns in the *longue durée*. This deductive focus also allows for an unbiased look at the colony before discussing to what extent these micro-patterns fit into the wider narratives of the economy of the Roman Empire.

Chapter 5 ***Berytus*: A Roman Port**

City-sacking violence will never cease to shake city-saving peace, until Berytos the nurse of quiet life does justice on land and sea, fortifying the cities with the unshakable wall of law, one city for all cities of the world.

- **Nonnus *Dion*ysiaca 41.394-8**

Inhabited since at least the Neolithic period, Beirut is a city with a long history of relatively uninterrupted occupation through the Bronze Age, Iron Age and Hellenistic period (Badre 1997; Kassir 2011: 33; Perring et al. 2003: 203). However, though it is associated with the commercially-proficient Phoenician coast, the city was 'overshadowed by neighbouring Canaanite-Phoenician cities at Tyre, Sidon and Byblos' (Perring et al. 2003: 195). After the Phoenician city was destroyed in 143 BC by Tryphon, a Seleucid ruler (Hall 2001-2002: 141), it went through several political upheavals before being incorporated into the Roman province of Syria in 64 BC (Butcher and Thorpe 1997: 291). Sometime around 15 BC, *Berytus* was made a *colonia* and settled with veterans from Legions V and VIII, resulting in an expansion of the existing city limits, a lavishing of public spaces, and a refurbishing of the harbour (Elayi 2010: 160-61; Hall 2004: 95; Marriner 2009: 210; Millar 1993: 36; Mouterde and Lauffray 1952; Perring et al. 2003: 204, 220; Reynolds 2003: 120; Seeden and Thorpe 1997: 236; Semaan 2015: 260; Stuart 2002: 98-104, Fig. 5). In addition, several new amphora types came into production in the city starting in the 1st century BC (Reynolds 1999; 2000b; Reynolds et al 2010). These developments suggest the port city to have benefitted economically from Roman colonisation, which translated into urban growth and expansion. With evidence of harbour installations utilised in the Roman period having been uncovered along the northern coast (Butcher and Thorpe 1997: 299, Fig. 8; Perring 1997: 25-6), we are now able to better understand the layout of *Berytus* as a port city.

This section examines several published reports that discuss the layout of the urban city grid in relation to the harbour to better understand *Berytus*'s development in the Roman period (Curvers 2002; Curvers and Stuart 2007; Elayi 2010; Elayi and Sayegh 1998; Elayi and Sayegh 2000). This is complemented by previous work that focuses on harbour installations (Perring 1997; Seeden and Thorpe 1997) as well as geomorphological analyses (Carayon 2008; Carayon et al 2011; Marriner 2007; 2009; Marriner et al 2008) to provide an overall characterisation of the site based on multiple lines of data. As mentioned previously, much work has focused on the Phoenician port in Beirut; the goal of this section is to propose a location for the Roman harbour based on architectural evidence, ceramic distributions, the urban grid of the city and geomorphological analysis. The lack of consistency across sites due to methodological differences and the inevitable issues that arise with multiple teams working in the same site necessitate an overall analysis of Beirut's ancient harbour that considers all excavated areas.

5.1 Background

5.1.1 Geographical Setting

Beirut is situated at a geographically strategic location along the central portion of the Levantine coast. The northern coastline is well-protected from the dominant southwest winds by a rocky promontory, and is characterised by several natural reefs and bays along the northern coastline (Semaan 2015: 234). These are known today as the Bay of Saint Georges, the cove of Ain el-Mreisseh, the cove of hotel Saint-George, and the Bay of Saint Andre, which likely constitutes the main port of ancient Beirut (Figure 5.1; Carayon 2008: 270; Davie 1987; Elayi and Sayegh 2000). However, their location along the northern shores also exposes them to the north-westerly winds at certain periods, mainly in Winter (Chapter 3; Carayon 2008: 269). The western and south-western facades are less suitable for urban settlement due to the prevailing south-westerly winds and swell, resulting in significant shore erosion and sedimentation (Sanlaville 1977). This area of Beirut (south-western part of the coastal plain, close to Khalde) is characterised by sandy dunes, which contrasts with the more fertile part of the promontory near Ras Beirut and Achrafieh (Thorpe et al. 2001: 18). This region was originally covered in mulberry orchards and vineyards (Davie 1987).

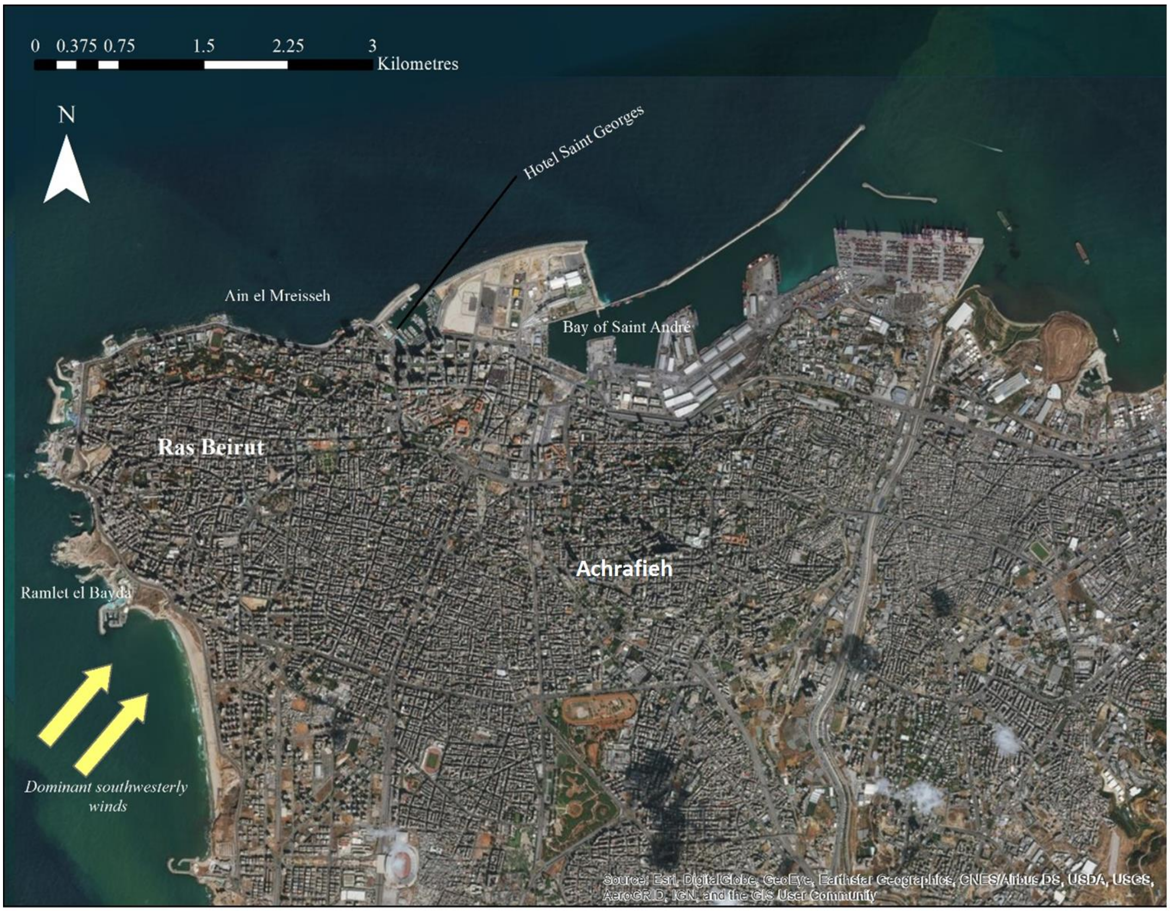

Figure 5.1: Closer view of Beirut depicting dominant south-westerly winds and primary bays on the northern façade of the rocky peninsula

In terms of its topography, Beirut is characterised by a relatively flat plain with two hills in the northern part of the site at Achrafieh and Ras Beirut. These hills provide an interrupted view of the coastal plain towards Shuayfat in the south, as well as an overall view of the coastline around the promontory (Davie 1987). Nahr Beirut (Beirut River) cuts through modern-day Achrafieh and has served as a consistent source of fresh water for the city throughout history. It has been proposed that in the Bronze and Iron Ages, this river created a marshy lagoon around its delta, forming a natural barrier that hindered travel in an E-W direction (Carayon 2008; Davie 1987: 146). As a result, movement is naturally inclined to follow the flat plain of Beirut west of Nahr Beirut as well as between the hills of Achrafieh and Ras Beirut (Davie 1987: 146).

The mountains directly east of the city generally do not exceed 1000m in elevation, and are intersected by a valley through which Nahr Beirut runs, with modern towns and villages dotting the highlands on either side. Several kilometres south of this valley lies the southern-most pass from the coast to the Bekaa Valley through the Mount Lebanon Range (Butcher 2003: 11). Based on the slope of the topography in the region, least-cost route analysis suggests that this path through the Mount Lebanon Range begins at the coastal plain in several possible locations (any green or yellow areas depicted in Figure 5.2 and Figure 5.3 south of the deep river gorge), continues east on a fairly straight trajectory, and arrives at Qob Elias in the Bekaa. The prevalence of this route is corroborated by the railway line as well as the modern Beirut-Damascus highway situated in the same place (Abou Diwan and Doumit 2017: 237, Figure 12). Unfortunately, the surrounding region has not been properly surveyed, and the location of Roman sites is not yet known (discussed further in Chapter 6). Areas in orange and red are quite steep in character, difficult to traverse and were probably not utilised as regular paths.

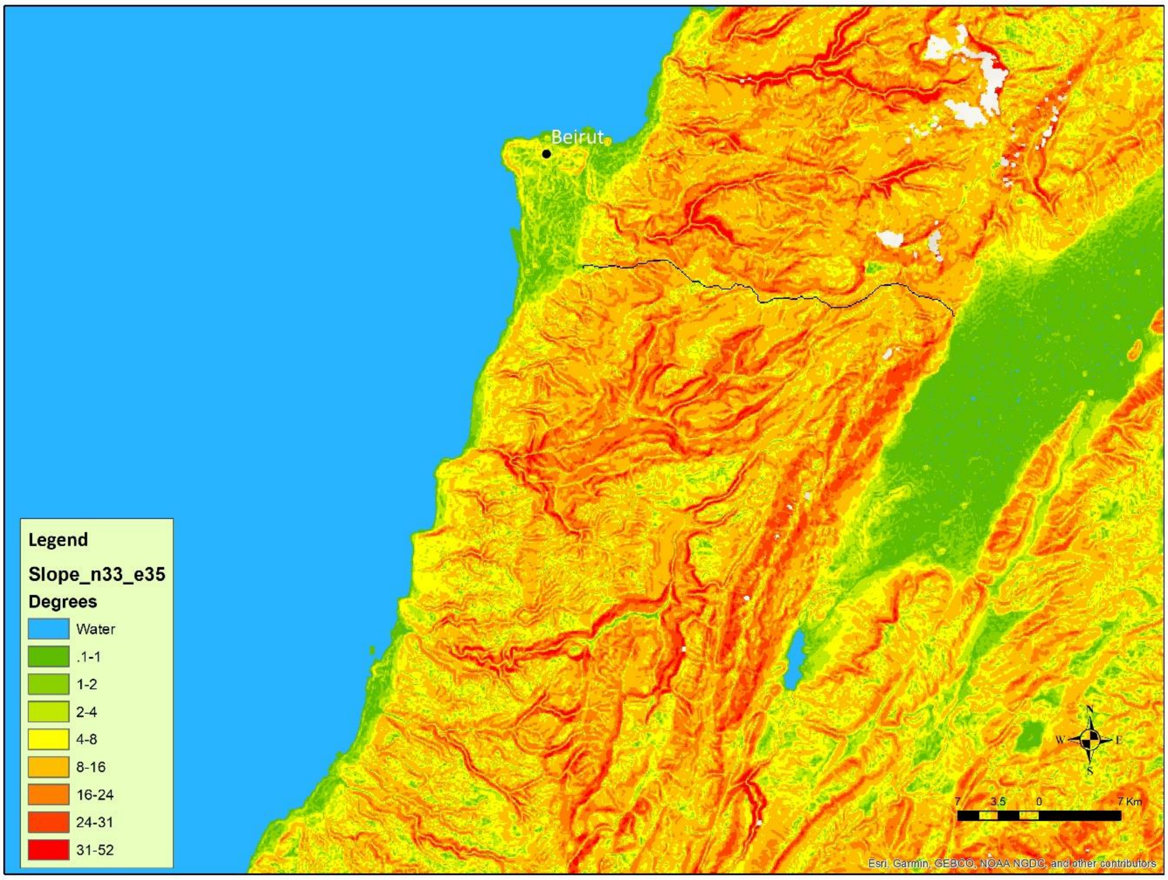

Figure 5.2: Slope map of Beirut and the surrounding region, with the least-cost route from Beirut's coastal plain (Kfarshima) to the Bekaa (Qob Elias) depicted in black, representing the southern-most pass from the Lebanese coast through the mountains

Both sides of the mountains around the Beirut River provide relatively flat land suitable for settlement, and gently slope towards the city. Travelling terrestrially to the city from the northern side is possible through a SW-NE directionality, represented in Figure 5.3 as the yellow and green route twisting through the highlands parallel to the valley of Nahr Beirut. The Roman sites of Deir el Kalaa (*Balmarcodes*) and Brummana (*Borama*) corroborate this proposition.

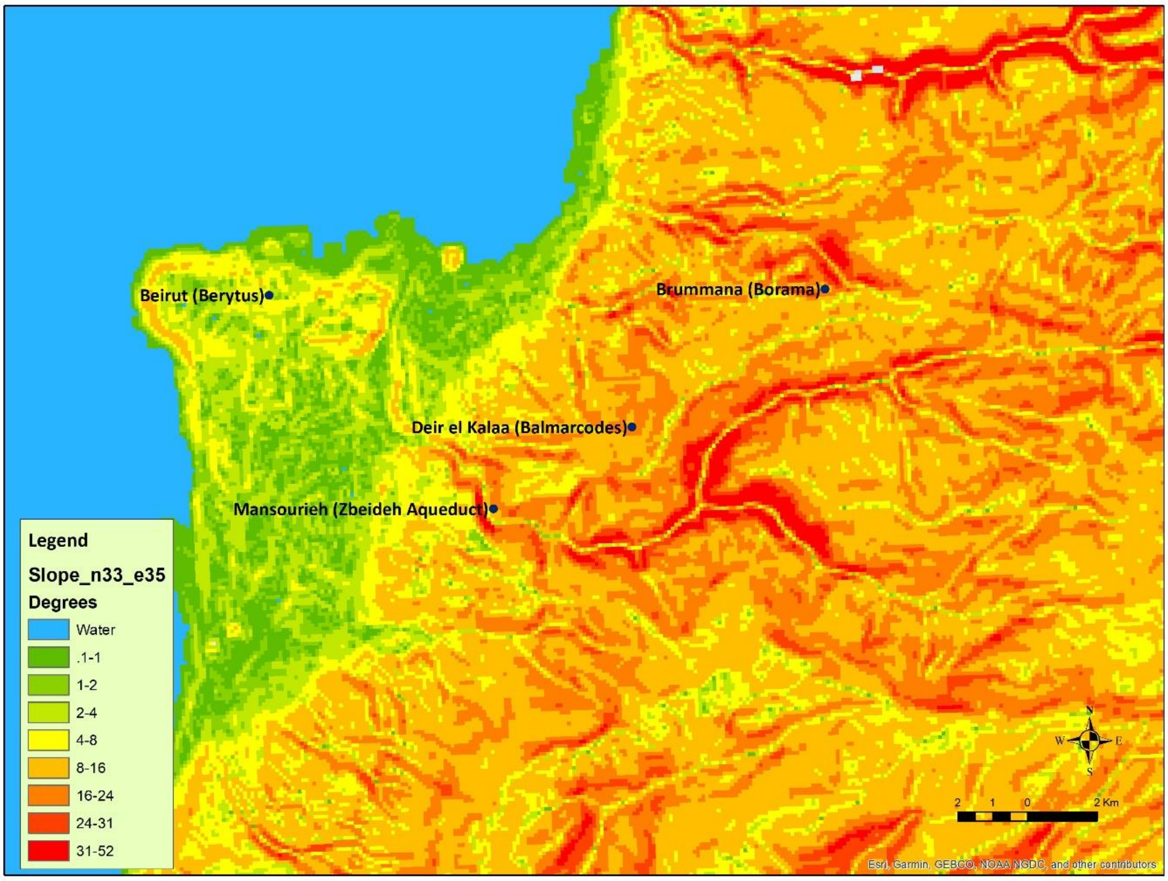

Figure 5.3: Alternate route into the Mount Lebanon Range east of Beirut with documented archaeological sites

5.1.2 History

5.1.2.1 Pre-Roman Occupation

All these factors made the enclosed space in the northern and north-western portion of the coastal plain well-suited for settlement, and provided a conducive environment that led to the continuous occupation of the region for thousands of years. Even in ancient times, the city was seen as infinitely old, as suggested by Nonnus sometime between the 4th and 5th centuries AD, who states Beirut to have been 'the nursemaid of cities… first to appear, born with time, old as the universe' (*Dionysiaca* 41.361-7; Rouse 1940). It is first mentioned in the Tell el-Amarna Tablets sometime in the 14th century BC as the city of *Biruta* (Curvers and Stuart 2005; Rainey 1995-96). In the late Iron Age/early Hellenistic period, Beirut is mentioned by Pseudo-Scylax as a 'city with a harbour' which is facing 'a little toward the north' (Pseu.-Scy. 104; Hall 2001-2002: 141). In the Hellenistic period, the city was known as 'Laodicea in Phoenice' based on numismatic evidence (Hall 2004: 46). Eventually, the original etymology led to the name *Berytus* for the new Roman colony.

Beirut was likely under Sidonian rule, or at least, it was a dependent of Sidon in the late Iron Age/early Hellenistic period (Elayi and Sayegh 2000: 334-5; Perring et al. 2003: 199). With the arrival of Alexander the Great, the Phoenician coast passed to Seleucid control after his death (Butcher 2003: 22). After years of internal strife and local disputes, Antiochus III 'the Great', the ruler of the Seleucid kingdom from 222-188 BC, began the first of many clashes with Rome (Butcher 2003: 27). Over time, the Seleucid kingdom declined and later rulers were forced to grant independence to some of the more powerful cities, such as Tyre in 126/125 BC, Tripoli in 112/111 BC and Sidon in 111 (Butcher 2003: 29). Beirut received its independence from Seleucid control by Tigranes, King of Armenia, in 81 BC (Butcher 2003: 23-6; Hall 2004: 45; Lauffray 1977). Thus, the city existed for several decades in the 'power vacuum' that had been left after his withdrawal and before the arrival of Pompey in 66 BC.

5.1.2.2 Roman Rule

Shortly thereafter, Beirut was incorporated as part of Roman Syria in 64-63 BC with Pompey's deposing of Antiochus IV and reorganisation of the political structure of the region (Hall 2004: 45; Sartre 2005: 43). In 42 BC, Mark Antony took control of the eastern provinces after the battle at Philippi, and eventually gifted a selection of land and cities (the Bekaa Valley and coastal towns) to Cleopatra (Jos. *Ant.* 15.95; Plutarch 51.2.1-2, 3.1; Hall 2001-2002: 142). This appears to have included most of the Levantine coast 'with the exception of Tyre and Sidon, which he knew to have been free from the time of their ancestors, although she earnestly pleaded that they be given to her' (Jos. *Ant*. 15.95). Thus, if Josephus' account can be relied upon, Tyre and Sidon still retained some of their autonomous power at this point.

After the defeat of Mark Antony at the hands of Augustus at the Battle of Actium, it is believed that Augustus settled two legions (V *Gallica* and VIII *Augusta*) in Beirut around 31 BC based on numismatic evidence and Strabo's reference to the settlement of soldiers after Actium (Strabo *Geog.* 16.2.19; Hall 2004: 46; Millar 1990: 12; 1993). However, it seems more likely that there was some delay between Augustus' victory at Actium and the actual settlement of Beirut. In Dio Cassius' record of Augustus' visit to the eastern provinces, he does not mention *Berytus*, but focuses on Tyre and Sidon and how Augustus punished them for their 'factitious quarrelling' (Dio Cassius 54.7.5-6). Based on the literary evidence in Jerome's *Chronicle*, which states 'the colonies of Beirut and Patras were founded' and 'Agrippa captured Bosforus' between 16 and 13 BC, it seems that a date closer to 15 or 14 BC is more accurate (Jerome 191.3; Dijkstra 2015: 154; Hall 2001-2002: 143).

After colonisation, *Berytus* rose quickly in appearance and dignity. The colony adopted some form of the *ordo decurionum* or *curia* (the administrative council), with members of this order practicing some kind of *munera* (duties) in the form of administrational management and, in certain cases, a monetary contribution or commissioning of public structures (*CIL* III.167; Derks 2012: 107; Hall 2001-2002: 148; Madsen 2013: 129; Rey-Coquais 1991). Various other local governmental positions are attested at *Berytus*, such as *quaestor*, *aedile*, *duumvir*, and *pontifex,* indicating that colonisation resulted in a formal recognition of typical administrational appointments (Hall 2001-2002: 148-9). Local rulers also favoured the city, and at different times were said to have bestowed monumental structures in the form of statues, sculptures and a theatre, as well as gifts of various kinds (Perring et al. 2003: 200). For example, Marcus Julius Agrippa II, a client king ruling in the southern Levant, was said to have given the populace of *Berytus* grain and olive oil and presented them with annual spectacles (Jos. *Ant*. 20.211-13). As will be seen in this chapter, the city grew and expanded its urban limits, and also received large tracts of land in the Bekaa Valley (Abou Diwan and Doumit 2016).

In the reign of Septimius Severus (193-211 AD), *Berytus* was grouped into the newly organised province of *Syria Phoenice*, which was a further subdivision of the Syrian province *Syria Coele* (Hall 2001-2002: 149-51). This period marks a fairly significant time of stagnancy in public and private construction (Table 5.2; Perring et al. 2003: 211), as well as a loss of fertile lands in the Bekaa with the establishment of Baalbek as an independent colony (Hosek 2012: 46-53). The site had formerly been a dependent of sorts within the territorial extent of *Berytus* (Butcher 2003: 136), though the nature of this relationship is unclear. Certain scholars have focused on the religious significance of Baalbek and the syncretism of various cults (Hosek 2012; Paturel 2019), while others have prioritised spatial characterisations based on the location of Latin and Greek inscriptions (Abou Diwan and Doumit 2016; 2017).

It is difficult to characterise the socio-cultural composition of the colony, especially in terms of the nature of the relationship between the local population and Roman settlers. On the one hand, there appears to have been some tension between the settlers and the local Ituraeans from the first century BC to the 1st century AD, who inhabited the southern Bekaa and Mount Lebanon Range, and periodically descended from the mountains to raid the coastal lands (*CIL* III.6687; MacAdam 2001-2002). Conversely, inscriptions from various sites within the territorial extent of *Berytus*, such as those found at Deir el Kalaa and Baalbek, point to a significant degree of religious, cultural and social syncretism (Aliquot 2015; Hosek 2012). This complex process of settlement and the intertwining of cultures cannot be comprehensively assessed in this short section. However, it can be asserted that ‘veteran settlement…had a major and long-term impact on civic culture, but in terms of its architecture and urban plan [*Berytus*] may not have been significantly different from its neighbours’ (Butcher 2003: 231). In this chapter, and in later sections, it will be shown that this also applies to other aspects of the colony through a comparison of commercial patterns with the development of the city itself.

5.1.3 The Beirut Central District Excavations

Excavation in Beirut first started in the 19th century (Elayi 2010: 156), followed by salvage excavations in the first half of the 20th century (Semaan 2015: 236). Early work was dominated by Jesuit scholars before and during the Mandate period (Curvers and Stuart 2007: 189). However, it was the French architect Jean Lauffray who conducted the first comprehensive investigation of the city and compiled a plan of *Berytus* (1945). Lauffray's work concentrated primarily on identifying buildings and proposing a street grid for the Roman city. He exposed several large bath complexes, a forum and public buildings interpreted as temples, among other various structures (Lauffray: 1945: 21-6, Pl. II.19). However, his focus was primarily on better understanding the Roman city in terms of the street grid and buildings, and as a result, much archaeological material was not processed systematically. Regardless, his plans have provided a useful base for more recent attempts at outlining the Roman, Hellenistic and Iron Age city grid (Curvers and Stuart 2007; Elayi and Sayegh 1998; 2000; Perring et al. 2003).

After Lebanon's capital was devastated in the civil war, a number of reconstruction projects were undertaken, revealing archaeological sites that required systematic excavation and analysis. With the end of the civil war in 1991, La Direction Générale des Antiquités (DGA), UNESCO and the Council for Development and Reconstruction (CDR) agreed on a plan to begin bringing in archaeological teams to work in the Beirut Central District (BCD) (Curvers and Stuart 1998-1999; Elayi 2010: 157). Thus, 14 local and international teams began a series of archaeological excavations throughout the city centre (Semaan 2015: 236). These salvage excavations were carried out rapidly, exposing Ottoman, Roman, Hellenistic, Iron Age, Bronze Age and Neolithic remains from the city (Perring et al. 2003). Results have been published in BAAL and the Berytus Series, though it is difficult to provide a full account of all archaeological work that has been conducted in Beirut since much remains unpublished (Elayi 2010: 157; Semaan 2015: 236).

Reynolds performed the ceramic analysis of much of the material emerging from the urban excavations in Beirut from the Roman period, ultimately making the identification of a new form of amphora that was produced in Beirut (Reynolds 2000b; 2005). His work is especially valuable since he has published ceramic frequencies of imports and exports (2000a), detailed analyses of the development of the Beirut amphora over time (2000b) and briefly proposed some theories of the economic organisation in the Roman colony based on this information (Reynolds 1999; 2005). Ala Eddine continued this work, publishing a more recent typology of the Beirut amphora (2005).

These works have been contextualised in relation to ceramic production sites along the Levantine coast (Wicenciak 2016a; 2016b). As a result, these publications have given us a good idea of regional typologies and their evolution over time, but a comprehensive analysis of the economic systems associated with the production and packaging of these amphorae is still lacking.

Furthermore, there is a lack of focus on remains from the Roman period, especially regarding the port installations uncovered in the north-western sector of the city. Several publications present the results of excavations in some parts of these areas (Elayi 2010; Elayi and Sayegh 1998; 2000), but do not comprehensively discuss the port city or harbour basin. They also prioritise Iron Age and early-Hellenistic strata without discussing refurbishment, reuse or upkeep in detail. Recent geomorphological work has seen significant advancements in this regard, specifically in shedding light on the location of the harbour basin, the progradation of the coast, the depth of the harbour, the upkeep required to maintain this draught, and the degree of protection afforded within the basin (Carayon et al. 2011; Marriner, Morhange and Beydoun 2008). Given these developments, it is now possible for a comprehensive characterisation of the port city of *Berytus* utilising the published material. This analysis can then be compared to other regional port sites to better understand Beirut's place within the wider network of port cities of the eastern Mediterranean.

5.2 **The Harbour of Beirut**

As mentioned earlier, Beirut has a number of natural coves on the northern façade of the rocky peninsula, all of which are protected from the dominant south-westerly winds. These natural affordances, combined with the accessibility of fresh water and a geographically strategic position, made Beirut a key maritime site along the Levantine coast. The BCD excavations have confirmed this characterisation with the uncovering of a number of harbour installations along the suggested ancient coastline (Curvers and Stuart 2007; Elayi and Sayegh 2000; Seeden and Thorpe 1997). The archaeological evidence has also been corroborated by geomorphological studies and core analysis that trace the development of the basin over time, indicating a relatively well-protected environment in the Bronze Age, artificial installations possibly built in the Iron Age and active up-keep in the form of dredging in the Roman period (Carayon et al. 2011; Elayi and Sayegh 2000; Marriner 2007: 392; Marriner, Morhange and Beydoun 2008: 2502).

However, prior to modern excavations and geomorphological analysis, the location of Beirut's primary harbour in the Roman period was a topic of speculation throughout the 20th century (Marriner, Morhange and Beydoun 2008). In 1987, Davie published a proposition for the urban layout of Beirut from the Bronze Age through to the modern era (see Figure 5.4). This hypothesis was based on five maps of Beirut drafted in the mid-19th century, previous archaeological surveys, photographic evidence and the city's geographical setting. The resulting urban grid and proposed coastline for the Roman city have provided the foundation for modern excavations, and proved to be quite accurate based on recent work.

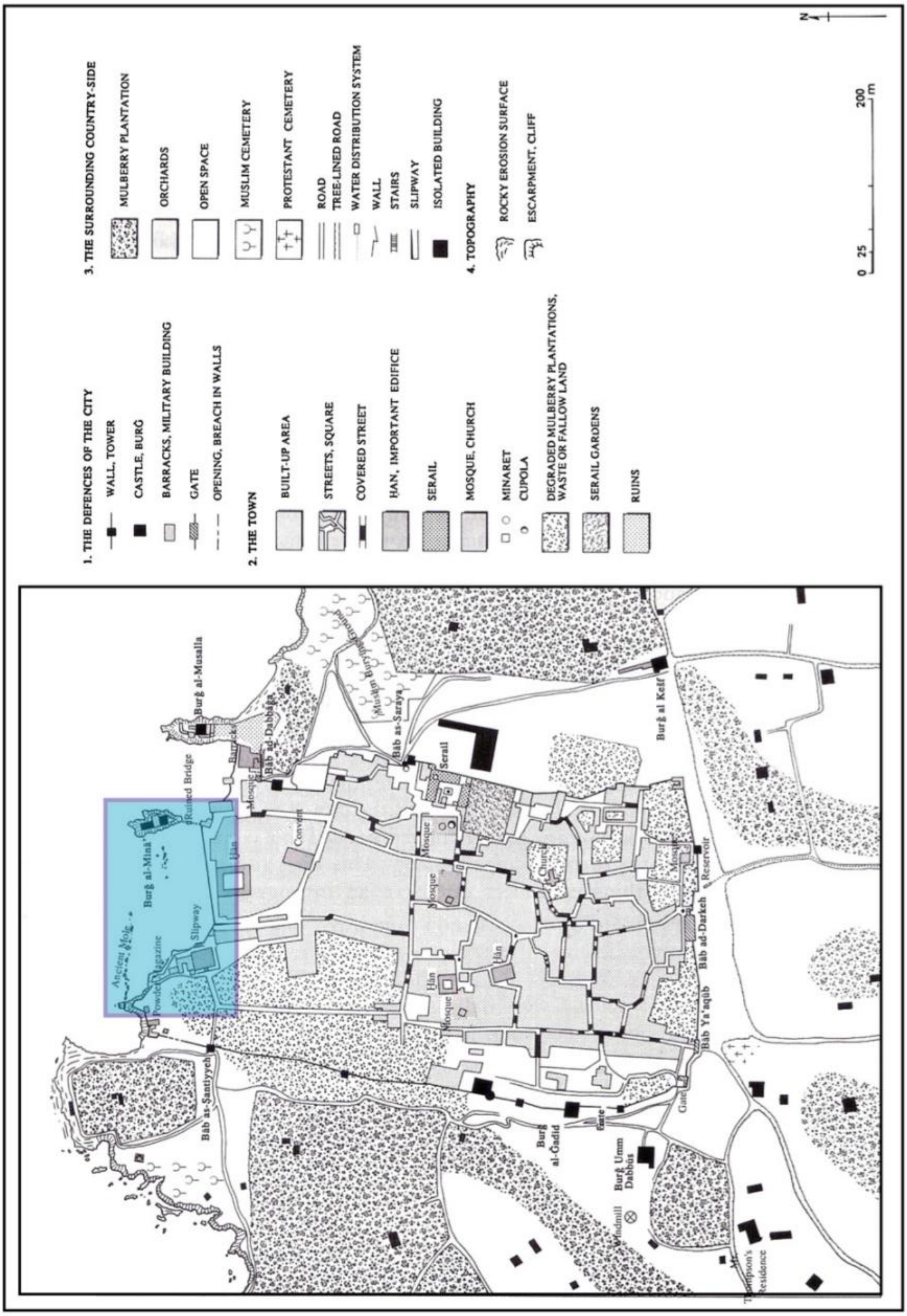

Figure 5.4: Davie's proposed location for the ancient harbour basin; the features depicted are from the Ottoman period c. 1830-1842 (after Davie 1987: Fig. 2)

For the purposes of this chapter and, ultimately, this thesis, it will be sufficient to summarise the work conducted in the ancient harbour basin (Iron Age-Roman period) and the nearby urban settlements, as the primary goal is to locate the harbour itself and explore its relationship to the city centre. Secondly, as Beirut has been continuously inhabited for thousands of years, it is useful to better understand the effect that Roman colonisation had upon the urban grid. It must be stated that this chapter is not meant to be a comprehensive analysis of Beirut, as such an undertaking is outside the scope of this small section and has been previously done (Curvers 2002; Curvers and Stuart 2007; Perring et al. 2003). Rather, this chapter serves to understand the functionality of the harbour over time, the infrastructure of maritime installations, and briefly examine the urban layout of the city in relation to the harbour.

The first section of this chapter outlines geomorphological analysis that has been conducted in Beirut to better understand the harbour, and re-examines the proposed location of the Roman coastline. The next section discusses physical remains of maritime installations and will utilise published material on of BEY 003, 007, 010, 032, 039 and 114. After this, I will examine urban remains and overall sequences around the ancient harbour basin by focusing on published reports on BEY 004, 006, 007, 009, 010, 045, and 069. Thus, any proposed conclusions are preliminary and based on the data in published material. Finally, I will then contextualise this data within the port city as a whole to better understand its development from a Hellenistic city through to a Roman colony.

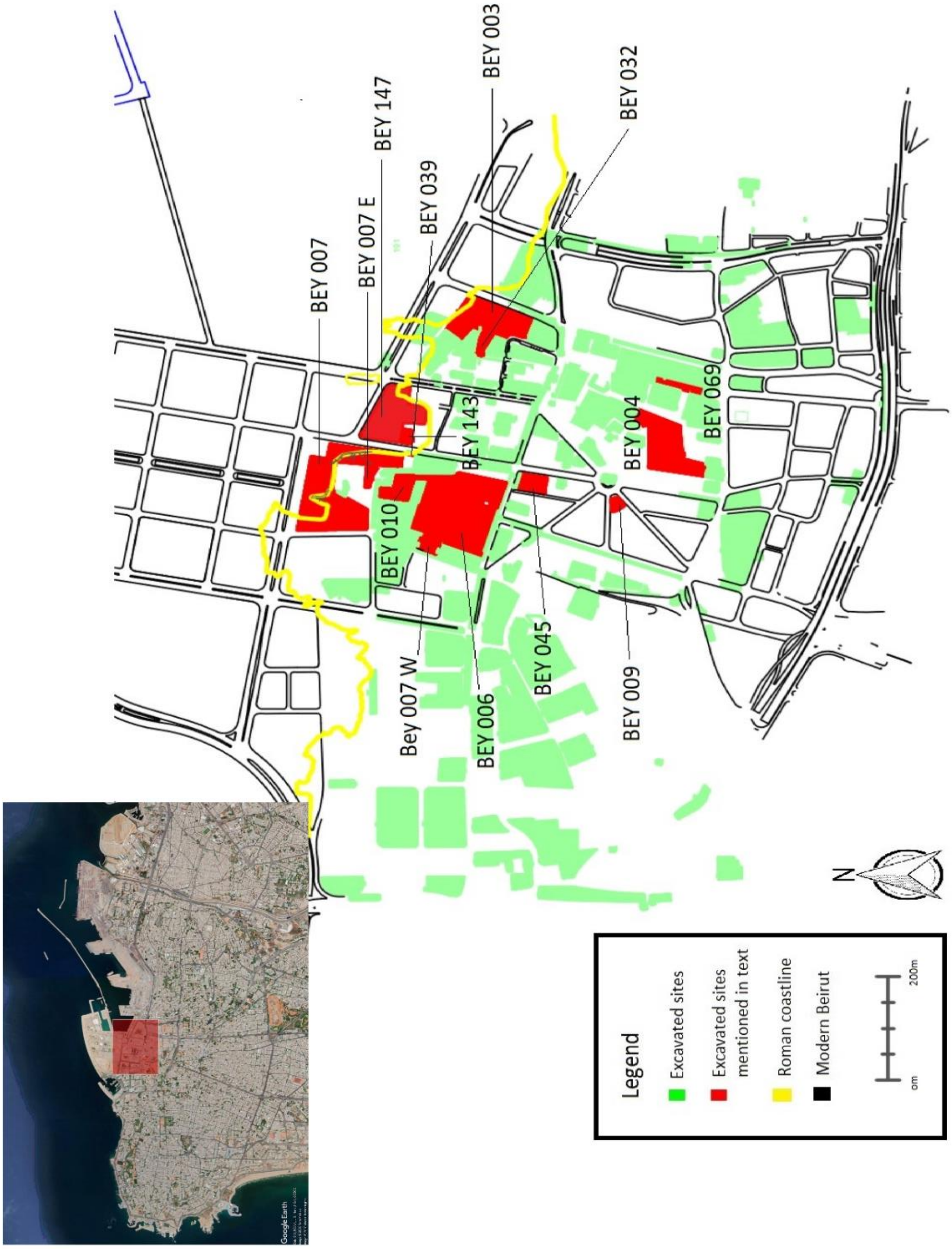

Figure 5.5*:* Map of Beirut depicting excavated sites, with sites discussed in this chapter in red and altered coastline following harbour installations in BEY 007 (data provided by Hans Curvers)

5.2.1 **Sedimentary Cores**

The ancient harbour basin of Beirut currently lies landlocked beneath the modern city along the northern coastline of the city. This coastal progradation is largely due to silting up from a lack of upkeep in the harbour since Antiquity, as well as construction works since the 19th century (Marriner, Morhange and Beydoun 2008: 2504). Urban developments have made excavation difficult and limited to specific times and locations in the city. Thus, geomorphological analysis provides crucial insights regarding the development of the ancient harbour over time using a non-destructive method.

As mentioned in 5.1.1, the western façade of the city was exposed to the dominant winds and waves as well as dangerous eddies, such as the one near Ramlet el Bayda (Davie 1987: 147). The western shores did not benefit from the natural protection of the rocky promontory of Ras Beirut, and any port would have been quickly filled in, especially as the sea is quite shallow in this area (Semaan 2015: 230). Thus, the primary focus for archaeologists and geomorphologists studying the ancient harbour of Beirut was the northern coastline, specifically the Bay of Saint Georges, the cove of Ain el Mreisseh, the cove of hotel Saint George, and the Bay of Saint Andre. As the archaeological material and ancient city largely centred around the Bay of Saint Andre, it was proposed to begin geomorphological analysis in this area (Marriner, Morhange and Beydoun 2008). Twenty-five cores were drilled in and around the hypothesised location of the ancient harbour basin in Beirut in collaboration with the BCD excavations (Carayon et al. 2011: 51). Twenty of these cores, depicted in Figure 5.7, were undertaken by Marriner et al. (2008). This campaign was based largely on Davie's proposed location for Beirut's ancient harbour (1987). The cores were drilled to the east and west of the ancient tell to test this hypothesis, and the results have been analysed to better understand geomorphological processes at play along Beirut's shores, focusing specifically on

1. Accurately relocating the city's ancient harbour(s)
2. Precisely reconstructing 5000 years of coastal deformation
3. Better comprehending human-environment interactions at both the local and regional scales (Marriner, Morhange and Beydoun 2008)

Analysis of sedimentary cores in this work largely follows the methodology outlined in Marriner and Morhange's work for characterising sediments and drawing patterns across harbour sequences throughout the Mediterranean (Marriner and Morhange 2007: 175-80). A summary of this methodological framework is depicted in Figure 5.6, though it must be noted that the temporal scale for these observations varies across regions in the Mediterranean (Marriner and Morhange 2007: 175). Diagnostic sedimentology is generally characterised by coarse beach sands in pre-harbour layers to fine-grained silts and clays in the harbour phase. The abandonment phase usually results in a transition to coarse sands and gravels. These sediments indicate initially a middle-energy environment (coarse beach sands), followed by a low-energy environment due to anthropological manipulation (fine-grained silts and clays) and eventually an abandonment phase (coarse beach sands which cap the sequence) (Marriner and Morhange 2007: 172). This sedimentary analysis is coupled with a consideration of biostratigraphy and archaeological material, and can be dated absolutely through radiometric techniques and ceramic analysis (Marriner and Morhange 2007: 180).

Facies/surface name	Definition	Diagnostic sedimentology	Diagnostic biostratigraphy	Geochemical imprint
Harbour Abandonment Facies (HAF)	- Degradation of harbourworks and exposure of the basin	- High to middle energy aggradational and progradational sets - Coarsening-up sequence	- Juxtaposition of diverse ecological groups (translate the exposed nature of the depositional environment)	- Weak
Harbour Abandonment Surface (HAS)	- (Semi)abandonment of the basin	- Transition from fine-grained harbour silts and clays to coarse sands and gravels		
Ancient Harbour Facies (AHF)	- Anthropogenically forced low-energy sedimentary environment	- Transition from coarse beach sands to fine-grained harbour silts and clays - Rapid fine-grained sedimentation rates (10-20 mm/yr) - Granulometric heterometry	- Ostracods = *Cyprideis torosa Loxoconcha* spp., *Xestolebris* spp. - Foraminefera = *Ammonia* spp. - Mollusc = *Parvicardium exiguum Loripes lacteus, Cerithium vulgatum*	- Strong
Harbour Foundation Surface (HFS)	- Natural to artificial interface	- Abrupt change from coarse beach sands to fine-grained harbour silts and clays		
Proto-harbour sands / Pre-harbour sands	- Natural beach sediments	- Aggradational coarse to medium grained sands - Coarsening-up sequence	- Coastal and semi-protected sub-tidal taxa	- Weak
Maximum Flooding Surface (MFS)	- Marine flooding of the coastal sequence (ca. 6000 BP)	- Transgressive sands and pebbles	- Coastal and semi-protected sub-tidal taxa	- None

Figure 5.6: Ancient harbour parasequence for harbours throughout the Mediterranean, detailing key facies and surfaces (after Marriner and Morhange 2007: 177, Fig. 31)

As seen in Figure 5.7, the cores targeted two main areas, with the majority located between Burj al-Mina and the Ottoman quays uncovered in the BCD excavations. The reason for this selection is largely due to the urban nature of Beirut which prevents drilling in certain areas (Marriner, Morhange and Beydoun 2008). The sedimentary analysis of these cores has painted a clearer picture of the harbour’s development over time, and helped confirm Davie’s hypothesis regarding the location of the ancient harbour.

Figure 5.7: Coastal change in Beirut based on core analysis and archaeological work (after Carayon et al. 2011: 52, Fig. 9; Marriner, Morhange and Beydoun 2008: 2502, Fig. 11)

5.2.1.1 Eastern Basin

Cores Be III, Be V, and Be XX, located in the anchorage east of Burj al-Mina (see Figure 5.7), have all revealed 'medium grain marine sands' which reflect an area not significantly sheltered (Marriner, Morhange and Beydoun 2008: 2504). It is possible that this sandy area could have been used as a fair-weather shelter from the Bronze Age onwards for shallow draught vessels, but based on recent analyses, it is certain that there did not exist a well-protected harbour comparable to that observed in the western basin (Marriner, Morhange and Beydoun 2008: 2504). As seen in Figure 5.7, these results seem to corroborate the general situation of the Roman city with the main forum lying on an axis perpendicular to the western harbour. The western edge of the eastern harbour basin lies near the outskirts of the city, and no harbour installations have been found in this area.

5.2.1.2 Western Basin

The western basin is located west of Burj al-Mina and was hypothesised to be the ancient city's main harbour (Davie 1987). This basin underwent significant transformations over different periods of occupation and it is necessary to better understand the rate of coastal progradation to situate the harbour more accurately, assess the nature of the marine environment, and specify any upkeep that may have taken place in the past. This thesis concerns itself primarily with the Roman harbour; thus the Bronze Age geomorphological processes will not be discussed in detail.

Based on the geomorphological analysis in combination with a quay uncovered in BEY 039 (see below), as well as a Middle to Late Bronze Age shoreline in BEY 069 (Marquis 2004), Marriner et al. (2008) have estimated a 70m progradation of the coastline between the Early Bronze Age and Roman period. As this figure is largely based on excavations, it is largely dependent on the dating of associated archaeological material. In this case, the feature uncovered in the BEY 039 sounding is often described as an Iron Age III/Persian quay, which has allowed it to be a marker for the rate of coastal progradation and the reformation of the ancient coastline from the Bronze Age through to the Roman period. It must be recalled that this identification is tentative, and the possibility of reuse of maritime installations in later periods could extend this timeline to the Hellenistic or Roman period, proposing a smaller degree of progradation between the Iron Age and Roman period. Thus, the Roman coastline proposed by Marriner et al. was likely much closer to BEY 039 than has been estimated.

As seen below, cores Be VIII, Be IX, and Be X were analysed in detail and samples were taken from each phase of each core for radiocarbon dating. Each core depicts a change from a high-energy marine environment to a low-energy marine environment based on the sequence of sediments

(Marriner, Morhange and Beydoun 2008: 2508). The transition from coarse-grained sand to silts and clays reflects the implementation of artificial harbour works in the Iron Age and Hellenistic/early Roman periods, which is corroborated by the faunal data observed in each core (Marriner, Morhange and Beydoun 2008). In Be VIII and Be X, there is a hiatus in sedimentary sequences observed between the Iron Age and Roman period, which has been interpreted as the result of dredging practices in the Roman period which removed earlier strata from the geological record (Marriner, Morhange and Beydoun 2008: 2508). This pattern seems to be consistent with Roman harbours in general, as dredging and regular upkeep of harbours became much more widespread at this time (Oleson 1988; Rickman 1988).

Be IX appears to be characterised by a wide depth range in the Byzantine period, as observed in Figure 5.9. The layer of 'harbour clays' begins just over one metre below MSL and continues to about 2.5 metres below MSL, and has been dated to the 5th century AD at the earliest level and between 680-880 AD at the latest level. This is indicative of a phase characterised by relatively poor upkeep where the harbour became silted over time (Marriner, Morhange and Beydoun 2008). However, the harbour basin remained well-protected during this time, given the prevalence of harbour clays which are indicative of a low-energy environment.

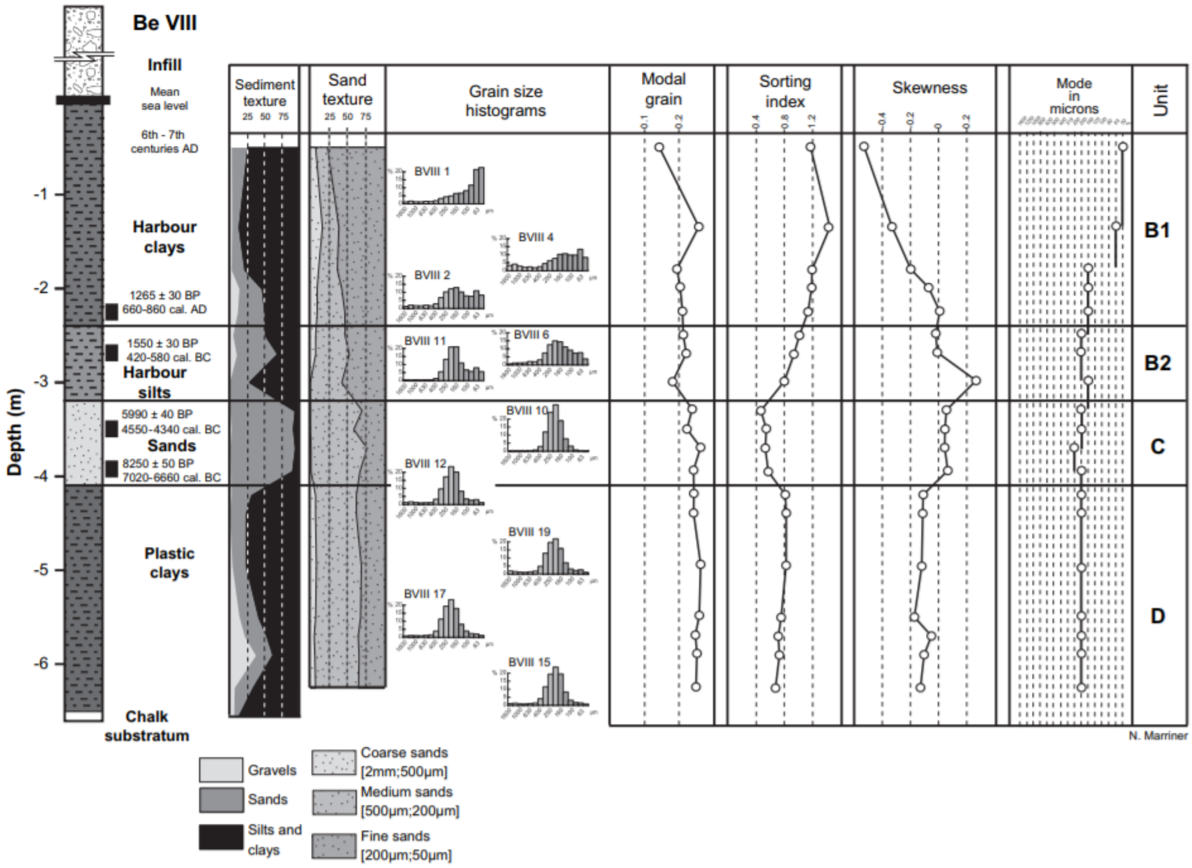

Figure 5.8: Sedimentary analysis of core Be VIII in the western basin (after Marriner, Morhange and Beydoun 2008: 2504, Fig. 13)

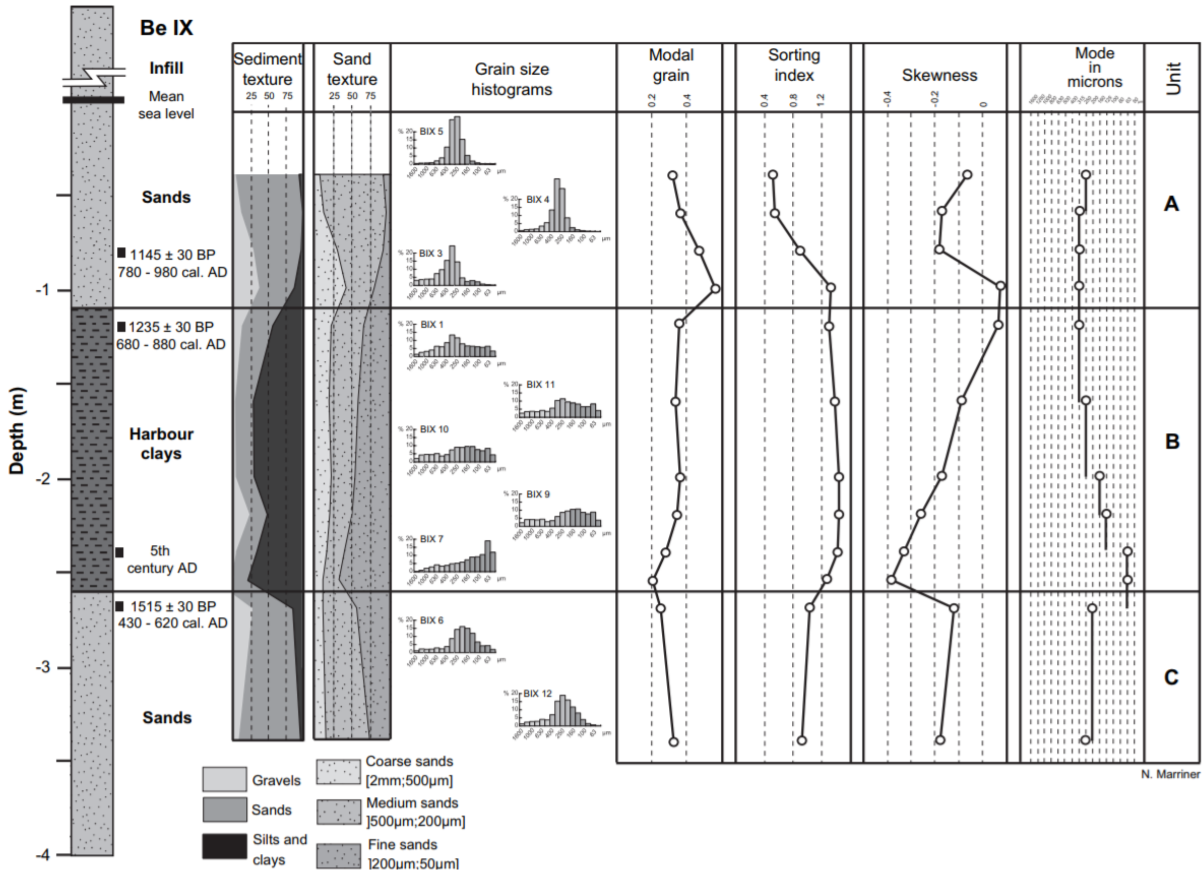

Figure 5.9: Sedimentary analysis of core Be IX in the western basin (after Marriner, Morhange and Beydoun 2008: 2505, Fig. 14)

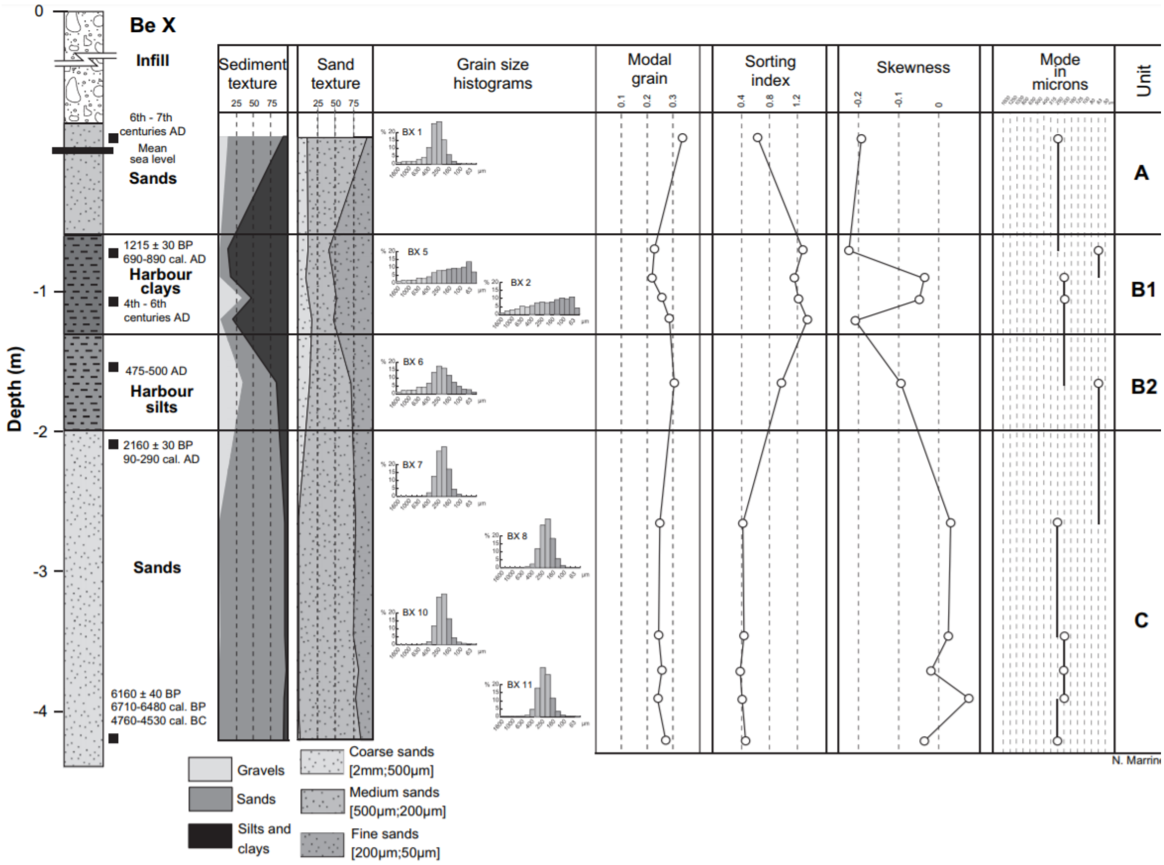

Figure 5.10: Sedimentary analysis of core Be X in the western basin (after Marriner, Morhange and Beydoun 2008: 2506, Fig. 16)

Ultimately, the results of the cores suggest Davie's proposed location to have been quite accurate, with a continuous utilisation of the harbour since at least the Iron Age. Each core suggests a period of consistent upkeep in the form of dredging in the Roman period, followed by a slow decline through the Byzantine period (Marriner, Morhange and Beydoun 2008). Throughout the Roman period, the harbour remained well-protected; however, the depth of the harbour, which appears to have ranged between 2 and 3 metres, lessened in the Byzantine period to roughly 1-2 metres. The coastline in 1840, shown in Figure 5.7 in yellow, is based primarily on Davie's map. The recreations by Marriner et al. (2008a) of the Hellenistic-Roman and Bronze Age-Iron Age coastlines were constructed based on a combination of the rate of progradation, sediment analysis of the discussed cores, and archaeological material. However, the interpretation of the quay uncovered in BEY 039 has proved to be key in this hypothesis. If the same installations were refurbished and reutilised in the Roman period, it would suggest the Roman and most definitely the Hellenistic coastline to have been farther inland.

5.2.2 **Harbour Installations**

Artificial harbour installations were uncovered by the BCD excavations in the sites of BEY 007 and BEY 039, at the south-western and north-western edges of the supposed harbour basin. Due to the severe coastal progradation in Beirut, these harbour works are landlocked and truncated by modern construction. Regardless, some of those uncovered in BEY 007 have been preliminarily dated to the 'Classical period' by the excavators without further specification, while the installations of BEY 039 have been attributed to the Iron Age III/Persian period (Thorpe et al. 1998; Elayi and Sayegh 2000: 226-31). In this section, I re-examine the excavation reports of these areas and incorporate data from BEY 143 and 147 (sondages presumably from within the harbour basin), along with the geomorphological data discussed in the previous section to provide a comprehensive assessment of the Roman harbour. Such a characterisation is lacking, since each site was excavated by independent teams that, unfortunately, do not appear to have collaborated in the final publication of their respective areas.

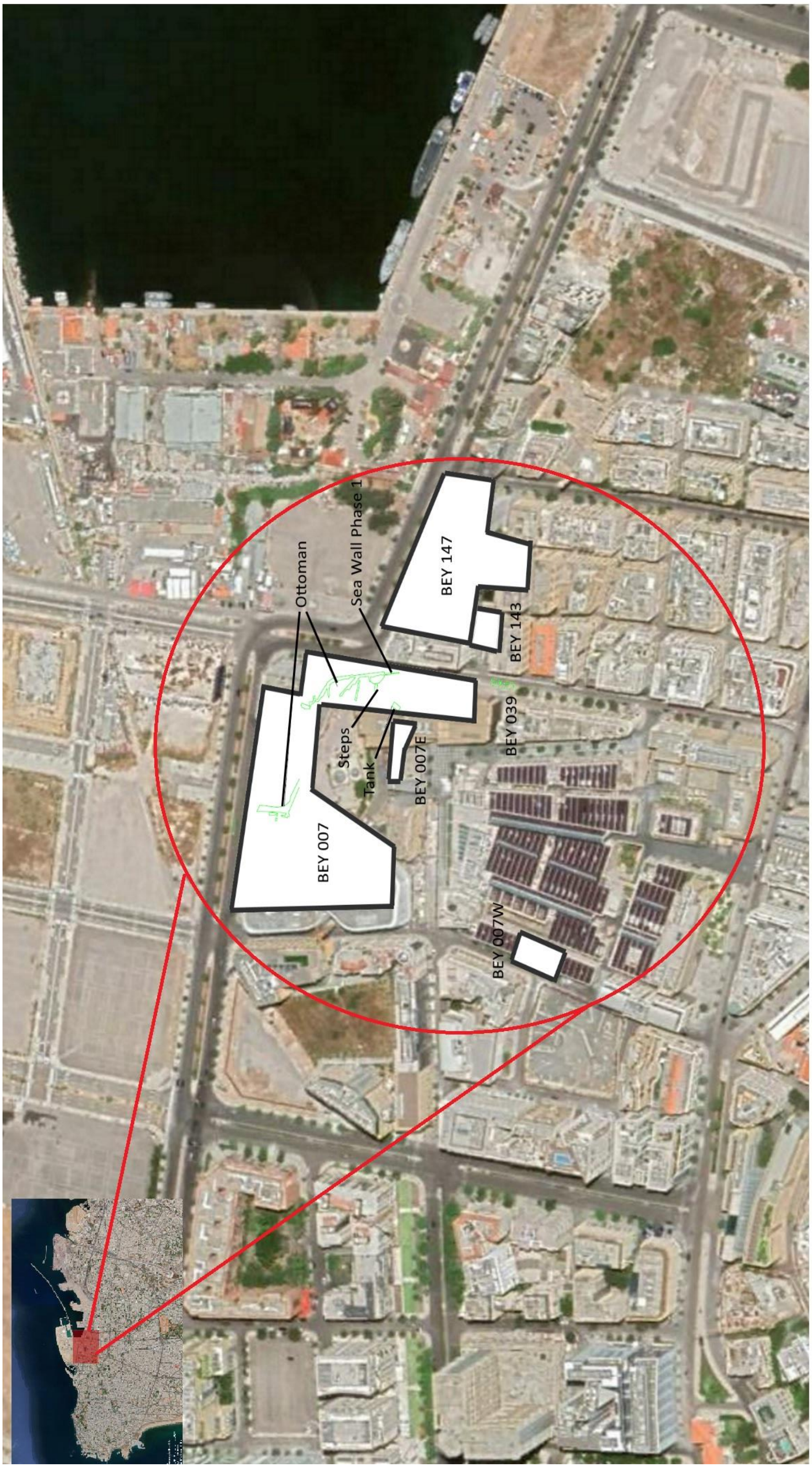

Figure 5.11: Closer view of sites related to the western harbour basin in BEY 007, BEY 039, BEY 143 and BEY 147 (see Figure 5.5); ancient installations are outlined in green (data provided by Hans Curvers)

5.2.2.1 BEY 007

BEY 007, located in the northwest region of the BCD excavations, was excavated by the AUB/ACRE team in 1996 (Thorpe et al. 1998: 31). Exploring the area offered a rare opportunity, as the site is situated on a high promontory that runs N-S, and appears to make up the western limit of the ancient harbour basin (Thorpe et al. 1998: 32). Excavators were hopeful to better understand the waterfront of the Hellenistic/Roman city and associated maritime activity. A number of maritime installations dated by excavators to the Classical period and Ottoman period were uncovered, such as several tanks, 'sea walls' and rock-cut steps. Unfortunately, preservation of archaeological material from the Roman period is quite poor (Butcher and Thorpe 1997: 299). Most of these deposits were fragmentary and truncated by later periods of activity in the Ottoman period as well as modern construction (Thorpe et al. 1998: 36, 43, 46). Regardless, as will be shown, the observed remains are actually quite useful in specifying the western edge of the harbour basin. Moreover, the attribution of remains to the Classical period can be further refined through comparisons with other excavated sites in Beirut and other port sites in the eastern Mediterranean.

5.2.2.1.1 Tanks/Vats

The eastern portion of the main area of excavation of BEY 007 turned up two large rock-cut tanks or vats of an unknown function (see Figure 5.12 and Figure 5.13). The only surviving portions of the tanks are those that were cut directly into the bedrock, with later phases having been truncated by Ottoman occupation and modern construction (Thorpe et al. 1998: 36). The surviving parts of the vats are around 3m x 1m in size and around 1.5m in depth (Thorpe et al. 1998: 36). The insides of the vats were plastered with a coarse, pink mortar with pottery and tile inclusions, and subsequently covered by a fine-grained pink mortar to give a more refined finish (Thorpe et al. 1998: 36). Much of this pottery has been roughly dated to the Classical period by the excavators, and similar vats dated to the late Roman or Byzantine period were found at BEY 006 (Thorpe et al. 1998: 38).

One possible function for these tanks could be as a fish tank, as described by Columella in his treatise on agriculture,

> '…the best pond is one which is so situated that the incoming tide of the sea expels the water of the previous tide… for a pond most resembles the open sea if it is stirred by the winds and its water is constantly renewed… The pond is either hewn in the rock, which only rarely occurs, or built of plaster on the shore… If the nature of the ground permits, channels should be provided for the water on every side of the fish-pond… It will be well

> to remember that gratings made of brass with small holes should be fixed in front of the channels through which the fish-pond pours out its waters, to prevent the fish from escaping.'
>
> **(Col. *De re rustica* 8.16.7)**

It is difficult to say definitively if these were indeed fish tanks, as the upper portions have been heavily truncated in the Ottoman period and from modern construction. However, they are reminiscent of basins found in Sarepta in the south of Lebanon, which are dated to the late Roman period and also theorised to be fish tanks (Pritchard 1971). They are identical in size, are carved into the bed rock, and lined with plaster. Similar examples have also been found at Chersonisos and Mochlos on the northern coast of Crete (Pritchard 1971). In Sarepta, the tanks were fed by carved channels, and located adjacent to the quay. In Figure 5.13, it appears that there might be signs of a channel on the right side of the feature, but later disturbance has made this identification difficult. However, as seen in Figure 5.12, the tank closest to Sea Wall Phase 1 (SWP1) is actually about 15m southwest of the feature. If the two features (quay and tank) are to be interpreted as contemporaneous, there may have been a problem in water flow reaching the tank consistently. Regardless, the interpretation as fish tanks is quite tempting as the basins observed in BEY 007 fit closely with Columella's description and are comparable to those found in Sarepta. Additionally, the tanks may have been used in the growing of *murex*, from which a purple dye could be produced for which the coastal Levant was famous throughout history (Arnaud 2001-2002). Another possibility is the utilisation of the tank as a basin for fresh water, as proposed for some of those uncovered in Sarepta (Pritchard 1971: 47).

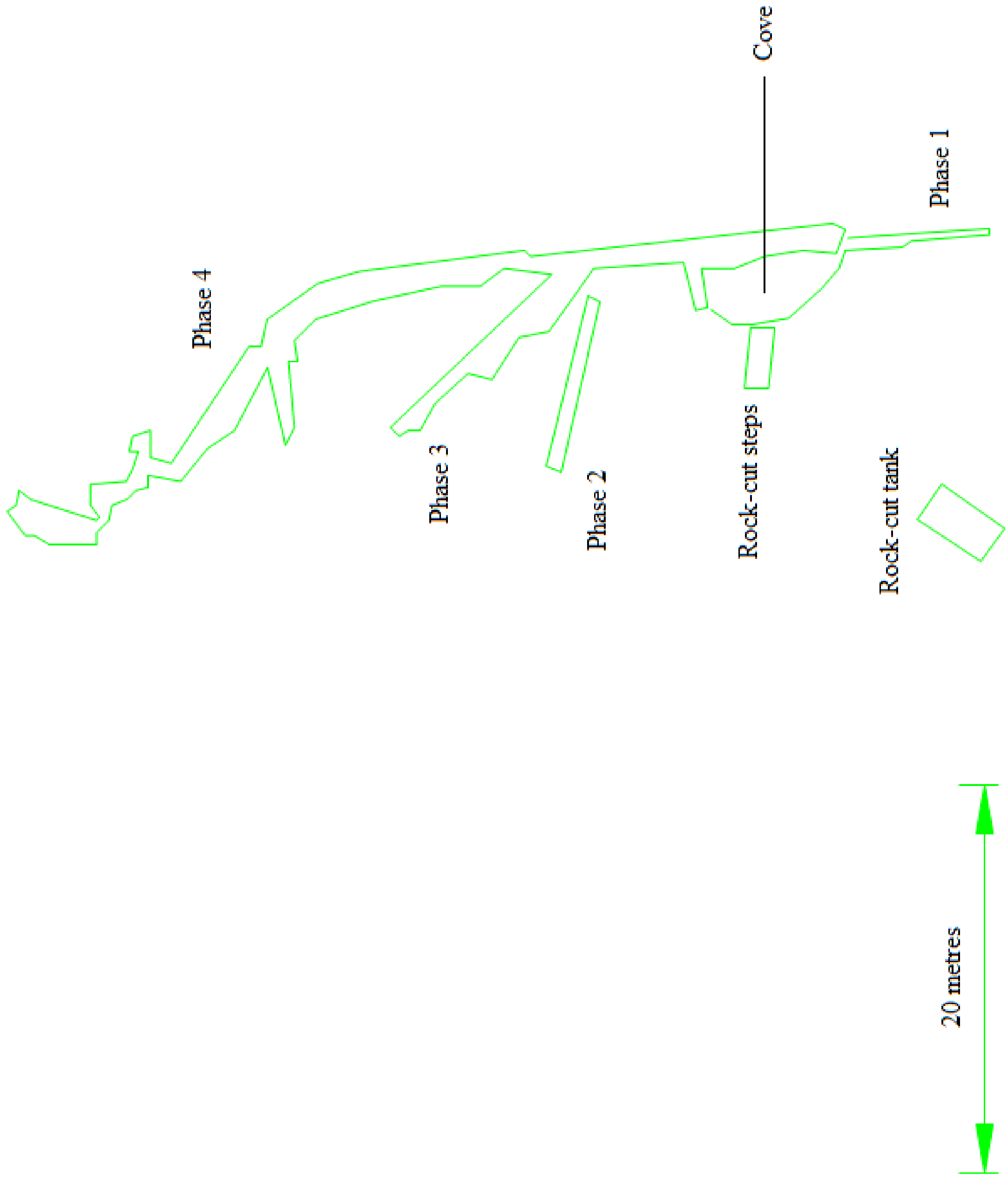

Figure 5.12*:* Closer view of harbour installations uncovered in the eastern area of BEY 007 (labelled Sea Wall Phase 1 in Figure 5.11); Phase 1 has been roughly dated to the 'Classical period' by excavators; Phases 2-4 represent the Ottoman quay (data provided by Hans Curvers)

Figure 5.13*:* Plaster-lined tank dated to the Roman period from eastern area of BEY 007 (after Thorpe et al 1998: Fig. 6)

Figure 5.14: One of the basins observed in Sarepta (after Pritchard 1971: III)

5.2.2.1.2 Rock-Cut Steps

In between these tanks, a sequence of ten rock-cut steps were uncovered on an east-west axis. They cut through the natural break of slope of the bedrock, with the lowest step on or just below the waterline (Thorpe et al. 1998: 36). More specifically, the lowest step cut through the level bedrock, and the sides of this cut were plastered with a pink mortar similar to that used in the vats described earlier (Thorpe et al. 1998: 36). The steps descend from west to east, eventually opening up and leading into a natural cove in the north-western corner of the harbour basin (Thorpe et al. 1998: 36-38).

At a later phase, a wall of squared and roughly faced sandstone blocks reinforced with a 'thick, weak, orange sandy mortar' overlay the plaster at the base of the rock-cut steps (Thorpe et al. 1998: 37). This wall has not been dated, though it was most definitely erected after the formation of the steps. At the north-eastern end of the cove, two courses of three squared limestone blocks were observed. These were joined with a thick, pink mortar with sandstone packing and faced on the southern edge, and the northern side of these walls was bonded to the projecting bedrock 'spur' (Thorpe et al. 1998: 37). Since only the southern side of the wall is faced, and the northern side is bonded to the bedrock, this indicates that the cove south of the wall would have been intended to be a closed-off space. As the rock-cut steps lead to this designated space which lies adjacent to the ancient coastline, it is quite likely that these features can be dated to the same period. Furthermore, it is possible that the rock-cut tanks discussed in the previous section are also of a similar time period, as attested by the presence of the same pink mortar.

A parallel can again be drawn with Sarepta, as similar rock-cut steps were observed leading from the edge of the quay to a nearby basin that was possibly used to purify water or hold fresh water (Pritchard 1971: 47-8). The distance of the tank observed in BEY 007 from SWP1 supports this proposition, as this would have prevented sea water from flowing into the basin. Other examples can be observed in Antiochia ad Cragum in south-central Turkey, which has been dated to between the 4th and 7th centuries AD (Marten 2005: 80), Dreamer's Bay in south Cyprus, dated to the Roman period, (James et al. 2018: 33), and Phalasarna, dated to the Hellenistic period (Frost and Hadjidaki 1990: 520-1). Thus, given the wide range of construction dates for these comparisons, it is difficult specifying a construction date for the steps observed in Beirut solely through these associations. Furthermore, the unique nature of the city's development and its exceptional status as a colony in Roman Syria may have resulted in different phases of construction and refurbishment in the harbour when compared to the wider region.

5.2.2.1.3 Sea Wall

In the eastern extension of the main area of excavation, a series of 'sea walls' were observed (Figure 5.11 and Figure 5.12). SWP1 runs in a slightly NW-SE direction, and has been tentatively dated to the Classical period by excavators based primarily on construction technique, and phases 2-4 to the Ottoman period (Seeden and Thorpe 1997: 228; Thorpe et al. 1998: 38). Phase 1 of the sea walls was uncovered in the south-eastern corner of BEY 007 and consists of large, ashlar limestone blocks set on roughly a northwest-southeast axis. The width of the wall varies from 0.3m to 0.7m (Thorpe et al. 1998: 38), though this variability could be due to the heavy truncation and poor preservation of the upper courses of the wall. Most of the ashlar blocks seem to be closer to 0.7m in width, with several outliers in the extreme south-eastern area of excavation. The upper courses of the wall lay between 1.83m and 2.50m above sea-level (Thorpe et al. 1998: 38).

This feature can now be more specifically identified as a quay based on its location adjacent to the rock-cut steps and cove, indicating that SWP1 lay on the coastline in the Roman period. Though the function of the feature is difficult to ascertain, its association with the steps and possibly the nearby tanks indicates that it might have served as a loading/unloading area in some capacity. The other possibility might be its association as a breakwater, based on a preliminary comparison with Tyre. However, a breakwater typically would have been constructed farther out to shelter an area within a harbour basin from waves and heavy currents, as depicted in numerous examples along the Levantine coast (Tyre – Noureddine 2008; Akko – Galili and Rosen 2008; Caesarea – Raban 1989; 2009). While a maritime installation might function as both (as seen in Sidon;

Carayon et al. 2011: 50), it seems much more likely that the quay of BEY 007, given its close proximity to the Roman coastline, did not provide a significant degree of shelter for the harbour basin. Furthermore, Levantine sea walls functioning as some sort of protective barrier between the sea and land, as attested at Batroun, Sidon, Tripoli and Arwad, were often carved into rocky promontories on the coast (Carayon et al. 2011: 51). In these cases, a thick section of rock was left on the coast after quarrying.

Figure 5.15: The Roman sea wall in Batroun, essentially the result of quarrying activity with an outer barrier left as shelter from wave action (photograph by author)

This construction technique of ashlar blocks being laid adjacent to one another and perpendicular to the coastline is quite typical of harbour construction in the eastern Mediterranean throughout the Hellenistic and Roman periods. Examples include Amathous in Cyprus (Figure 5.20) (Hellenistic construction date – Empereur 2016), Sarepta (early Imperial period) (Pritchard 1971) and Tyre in south Lebanon (Noureddine proposes an Iron Age date, while Carayon suggests an early Imperial period) (Carayon 2008; Noureddine 2008; Noureddine and Mior 2013). However, without ceramic material or numismatic evidence, it is difficult to more closely date the structures (as attested in the wide variety of construction dates of the abovementioned examples). Regardless, there are two main characteristics that help understand the context of SWP1. Firstly, a greyish mortar was observed between the ashlar blocks (Curvers, personal communication). As will be seen in the next section, a similar bonding agent was noted in BEY 039 in the latest phase of a quay uncovered by Elayi and Sayegh (2000). Secondly, the blocks are almost identical in size to those observed in the latest phase of the quay in BEY 039. For this reason, it is possible that SWP1 might be an extension of the feature observed in BEY 039; this is discussed further below.

5.2.2.2 BEY 039

The excavation of the regions of BEY 010 and BEY 039 was conducted by a team consisting of students of the Lebanese University under the scientific direction of H. Sayegh (Elayi and Sayegh 2000: 15). This endeavour has been established as a salvage excavation, as the planned construction in the areas of BEY 010 and BEY 039 implied the total destruction of archaeological remains (Elayi and Sayegh 2000: 15). The team explored a region of about 3000 m^2, uncovering well-preserved remains consisting of five streets and eighteen buildings (Elayi and Sayegh 2000: 15-6; 168-70; 188). However, the excavators were restricted in terms of funding and time; as a result, excavations in BEY 039 were limited to soundings, which revealed harbour installations in the north-western region of the Beirut excavations (Elayi and Sayegh 1998; 2000: 18). These remains were exposed, documented and subsequently destroyed during modern construction sometime around November 1996 (Elayi and Sayegh 2000: 16). Despite the lack of funds and the characterisation of the work as rescue excavations, the results have been published due to the importance of such harbour works in helping locate the ancient harbour and understand its development through time.

In these endeavours, the excavators prioritised Iron Age remains and did not lay out a methodological framework for approaching possible maritime installations characteristic of a port context. This is understandable, especially under the time constraint and the arduous nature of the excavations. However, as will be seen, this makes the subsequent analysis of the remains troublesome since, in certain cases, archaeological material associated with specific deposits (coins, ceramics, metals, etc.) were not categorically processed and catalogued. For some architectural features and stratigraphic layers, descriptions of the material are given with no photographs, typologies or detailed analysis. Regardless, the published material gives us a unique opportunity to examine rare maritime installations in Beirut and situate them within the Roman port city.

In area BEY 039, a sounding of $68m^2$ was excavated on the western side of Allenby Street (Elayi and Sayegh 2000: 225). As seen in Figure 5.17 and Figure 5.18, the sounding revealed what appears to be a quay with a possible mooring post. This find corroborates Mouterde's plan of archaeological finds in the city where he identifies a quay situated at Allenby Street (1942-43: Fig. 17.11). The quay is characterised by a several rows of rectangular, limestone, ashlar blocks associated with three phases of construction. The limestone blocks are situated longitudinally and oriented in an E-W direction, running N-S (Elayi and Sayegh 2000: 229). Though the stratigraphic sequences are complex and the area was quite disturbed, three strata can be roughly distinguished.

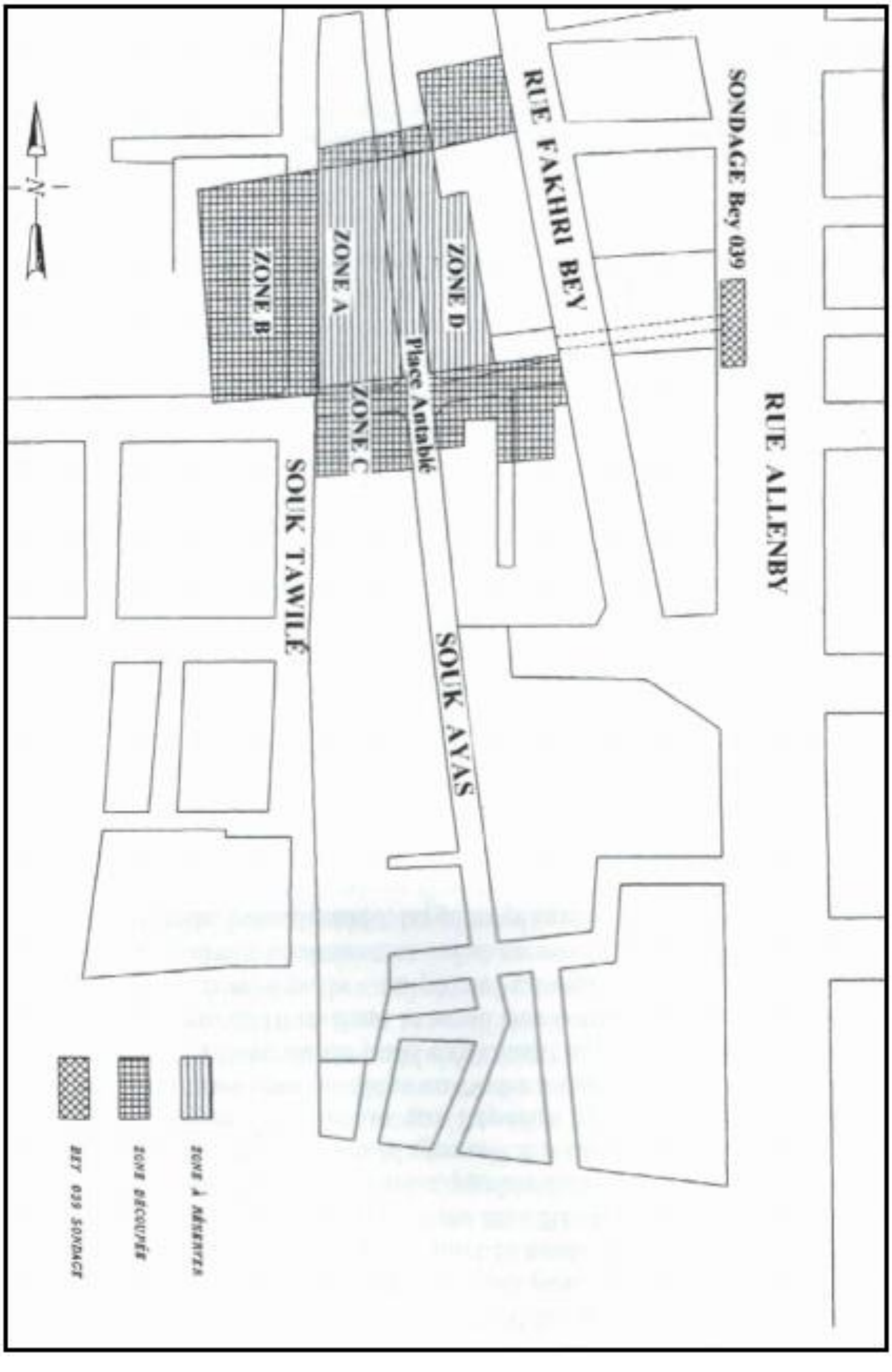

Figure 5.16*:* The areas of BEY 010 (Zone A-D) and BEY 039 (after Elayi and Sayegh 2000: Fig. 2)

5.2.2.2.1 Stratum I

Stratum I is situated 0.95m above actual sea-level and was uncovered about 2.45m beneath Allenby Street. It is composed of ashlar blocks consisting of ramleh (3.1.1). The stones are 0.60m long by 0.30m wide, and are bonded together by a greyish mortar, composed in part by lime and ash (Elayi and Sayegh 2000: 230). About 1.40m from the edge of the quay, a cylindrical mooring post of the same ramleh material was uncovered, with two deep grooves on either side, likely from the usage of moored ships (reflecting the use of a rope to tie off ships). It was also found slightly inclined towards the harbour, which may be the result of repeated use (Elayi and Sayegh 2000: 230). This mooring post was the only one found; however, gaps in the array of limestone blocks were located at regular intervals in relation to the mooring post. One 4.30m north of the mooring post and 1.40m out from the quay, and the other at 4.20m south of the post and about 1.60m out from the quay (Elayi and Sayegh 2000: 230). Finally, several Roman bronze coins were found *in situ* in context with the blocks in Stratum I along with a needle possibly for repairing fishing nets (Elayi and Sayegh 2000: 230). Unfortunately, while Roman ceramic sherds were noted in the excavators' overall stratigraphic sequences (Elayi and Sayegh 2000: 226-31), they have not been specifically linked to the three strata of the quay.

Figure 5.17*:* Part of sounding in BEY 039 (after Elayi 2010: Fig. 8)

Figure 5.18*:* A bollard observed in the sounding of BEY 039 (after Elayi 2010: Fig. 9)

The use of mortar to bind the stones together is typically associated with Roman engineering, though it seems to have come into use earlier (Blackman 1982b: 197; Mouterde 1951: 30). As this stratum overlays two other rows of ashlar blocks which were not bonded with mortar, and some Roman ceramics and a coin were found among the stones of this stratum, it is likely that this layer represents the refurbishment of older harbour installations in the Roman period with new construction techniques, or at least the continued utilisation of installations erected earlier. As observed at Atlit, Tyre, Sidon and Akko, this is quite typical for maritime sites in the region in the Roman period (Galili and Rosen 2008; Haggi 2010; Marriner et al 2014). This proposition is also corroborated by the large number of *Sigillata* and other ceramic sherds from the Roman period that were observed throughout BEY 010 (Elayi and Sayegh 2000: 196-9), the settlement immediately adjacent to the quay. Unfortunately, since BEY 039 was excavated as a sounding, detailed stratigraphic sequences are difficult to establish without systematically collected material and detailed measurements, diagrams and photos.

Mooring stones are also a common feature of harbours in the Hellenistic and Roman periods, as attested at Ierapetra in Crete (Mourtzas and Kolaiti 2017), Portus (Wilson et al. 2012: 383), Piraeus (Blackman et al. 2013: 475), Seleucia Pieria (Erol and Pirazzoli 1992: 324), Caesarea (Oleson et al. 1984: 300), Sarepta (Pritchard 1971; 1978) and Akrotiri (James et al. 2017), among others. The spacing between the possible mooring stones in Beirut (roughly 4 metres) is indicative of small to medium-sized vessels, especially when compared to the 14-15 metres of spacing observed at the Trajanic Hexagon in Portus (Wilson et al. 2012: 383).

Interestingly, this phase is near identical to the quay in BEY 007 in the placement of the ashlar blocks, the size of the stones and the use of mortar. This might indicate the two features to be related in some way, possibly even being from a single mooring area running along the western edge of the harbour basin. They lie roughly 70m apart, indicating that both features combined might have provided a mooring area at least 100m long. This is quite conservative compared to other ports in the eastern Mediterranean, as seen in the 130m long mooring area at the town of Ierapetra, Crete (Mourtzas and Kolaiti 2017), the 600m long quay of Caesarea (Raban 1989: 288), or that of Hellenistic Delos, which measures 1700m (Blackman 1982b: 202). Thus, given the similarities between Stratum I of BEY 039 and SWP1 of BEY 007, it seems quite possible that they represent a cohesive feature. If these two features are to be understood as contemporaneous, this would alter the Roman coastline proposed by Marriner et al. discussed earlier (2008). More specifically, the actual coastline in the Roman period would have run from BEY 039 to BEY 007, placing it about 70m farther inland than initially anticipated.

5.2.2.2.2 Stratum II

Stratum II, located about 0.65m above actual sea-level and about 2.75m beneath the lower part of Allenby Street, is characterised by a similar row of ashlar blocks in the same orientation. These blocks are considerably larger, measuring on average 0.60 wide, 0.50 high, and more than 1m in length (Elayi and Sayegh 2000: 230). They are assembled *joint vifs*, joined together without mortar through overlapping stones to reinforce the structure. More specifically, not all the ashlar blocks are perfectly rectangular and situated regularly. Rather, certain stones are carved to fit into each other (see Figure 5.17, centre of photo). Several blocks were joined together with lead-enforced dovetail joints, possibly those that would have been most exposed in order to reinforce that part of the quay, since they would have been under the most duress. A second bronze needle for the repair of fishing nets was also discovered between these blocks (Elayi and Sayegh 2000: 230).

The construction technique of joining two blocks together through a joint, sometimes reinforced with lead, is also observed at a number of sites throughout the eastern Mediterranean such as Elaia, Sarepta, Akko, Araq el-Amir and Dor (Elayi 2010: 160; Pritchard 1978; Sharon 1987: 38). The use of the dovetail joint is usually associated with Hellenistic construction (Elayi and Sayegh 2000: 231; Martin 1965:254-5; Raban 1991; Seeliger et al. 2013), though it may have been utilised over a long period of time and should not be used as a definitive dating method. The technique has been observed at Elaia in modern-day Turkey, with an estimated date of construction at the end of the 3rd century BC (Seeliger 2016), and at the harbour of Amathous, where the estimated date of construction is around 315 BC (Empereur 1987b: 2016). However, in the Roman port at Sarepta, a number of blocks of the Roman jetty were also joined together using a similar joint

(Figure 5.21). The date of construction of the first phase at Sarepta has been dated to the 1st century AD (Pritchard 1971).

Stratum II is characterised by large headers set parallel to each other, similar to the method depicted in b1 of Figure 5.19. This technique, similar to that observed in BEY 007, is quite typical of Phoenician construction (Iron Age to Hellenistic), though its actual manifestation is variable across the Levantine shore. In the harbour of Tyre, for example, large ashlar blocks of comparable size are laid in the same fashion (Noureddine and Mior 2013). Two courses have been observed in the underwater surveys conducted by Noureddine and Mior (2013), with a third protruding through the sediments at certain places. However, Tyre is notorious for the lack of consensus in the dating of the mole. For Carayon, the feature could be associated with a later period, possibly no earlier than Roman (2008: 651). Based on preliminary sedimentary soundings, it is supposed that there existed a previous mole, possibly dated to the Iron Age/Persian period (Carayon 2008: 651). However, the study of 70 pottery sherds collected during the excavation of the mole by Descamps and Sicre indicates an earlier date of construction, possibly between the 6th and 4th centuries BC (Castellvi et al. 2007: 68). Thus, again, construction techniques utilised in the erection of maritime installations must be approached with caution.

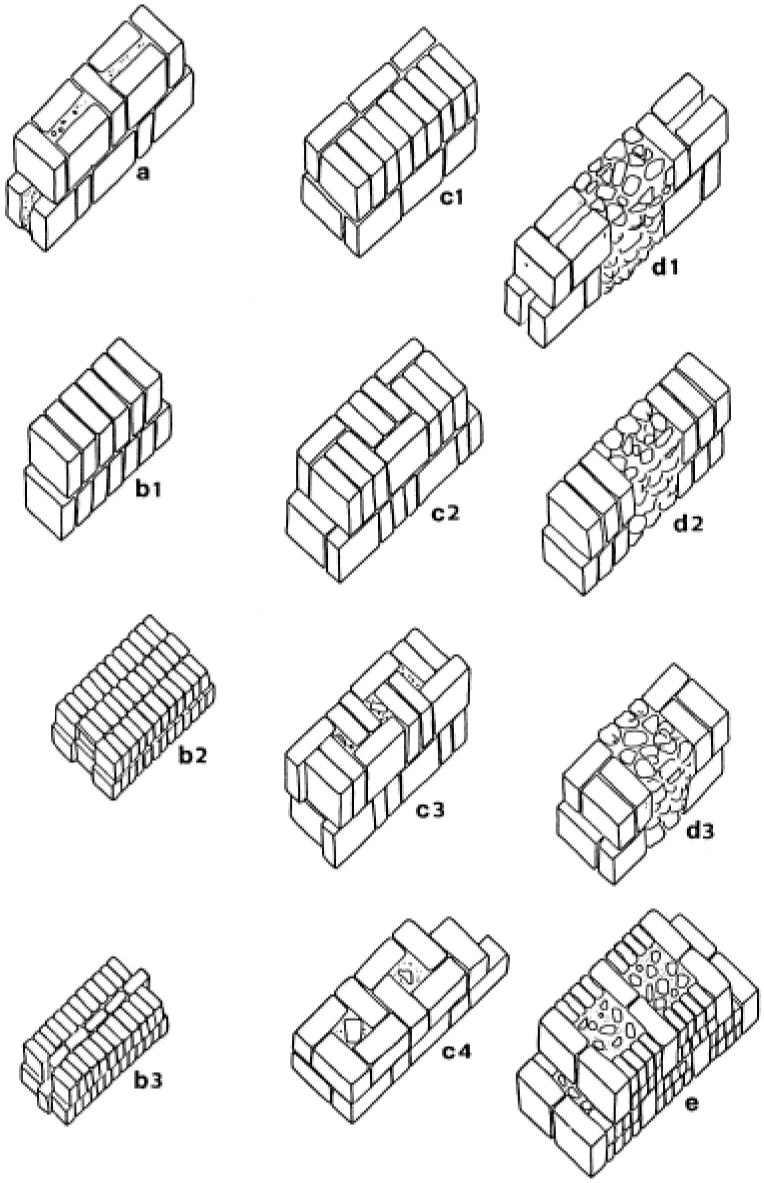

Figure 5.19: Ashlar construction techniques in the Levant from the Iron Age to the Hellenistic period; of particular interest is technique ‘b1’, which appears to be the method utilised in BEY 039; this method is dated to the Hellenistic period, though it has been observed in sites dated to the Iron Age, and described as a form of the ‘headers out’ technique (after Sharon 1987: Fig. 2)

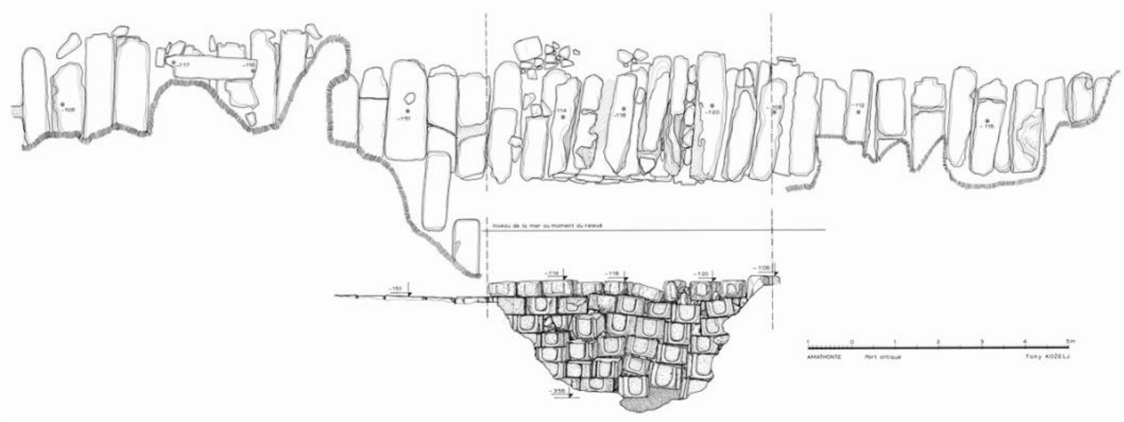

Figure 5.20: Jetty composed of large, ashlar blocks in the port of Amathous, Cyprus (after Empereur 2016)

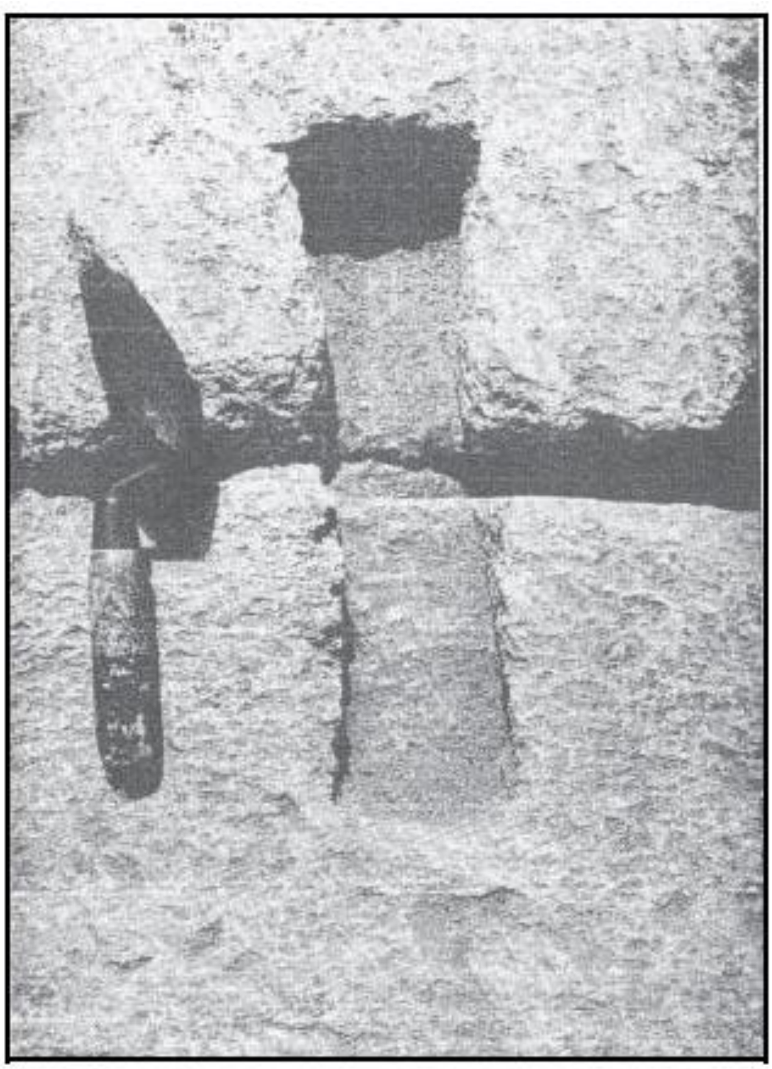

Figure 5.21: Joint between two ashlar blocks of the jetty in Sarepta (after Pritchard 1978: 51, Fig. 20)

Figure 5.22: Example of dove-tailed joint observed in breakwater at Elaia (photo courtesy of Nicholas Carayon)

5.2.2.2.3 Stratum III

Stratum III was found at 0.15m above actual sea-level and 3.25m beneath Allenby Street. This layer is quite similar to Stratum II in terms of the dimensions of the ashlar block which were laid in the same layout and orientation (Elayi and Sayegh 2000: 231). These blocks are joined in a similar fashion to that of Stratum II with overlapping stones (*joint vifs*), with certain blocks joined with dovetail joints. Several large hollow cavities were observed with traces of reddish brown material at the interior, indicating the utilisation of iron joints, presumably coated in lead to prevent damage to the stones (Elayi and Sayegh 2000: 231). At the borders of the quay, it appears that the blocks faced towards the sea, though they have very much eroded (Elayi and Sayegh 2000: 231).

5.2.2.3 BEY 143 and 147

The sites of BEY 143 and 147 provide crucial context for the propositions discussed above. They lay adjacent to the harbour installations of BEY 007 and 039, and west of Burj al-Mina, presumably the location of the Roman harbour. Excavations did not reveal any structural remains, but several soundings help corroborate geomorphological analyses presented earlier, and also shed light on possible phases of activity in the harbour (Curvers and Stuart 2007: 193-4).

The lack of structural remains is unsurprising, given that the sites are located in the centre of the supposed harbour basin in the Hellenistic and Roman periods. Cores VIII, IX, and X were taken from these sites, revealing sedimentary sequences reflective of a sheltered harbour basin that was dredged fairly consistently. Thus, any possible breakwater or mole would have been placed farther north, closer to the edge of the harbour basin as opposed to within the examined region. Rather, the value in the soundings conducted in BEY 143 and 147 is in establishing more developed stratigraphic sequences through the consideration of archaeological material. Results have not been extensively published, but there exist some limited unpublished reports discussing a general stratigraphy for both sites, complemented by spot-dated ceramics (Figure 5.23; Curvers and Stuart 2007).

Analysis of the deepest soundings has resulted in the uncovering of diagnostic Hellenistic material and 1st century AD bowls (Curvers and Stuart 2007: 189). This material underlays the 'black layers' detailed in Figure 5.23 in the southern section of BEY 143. The black layer observed has been dated to about 500-800 AD through C^{14} dating (Curvers, personal communication), indicating a gap in the sediments from the 1st century AD to the 6th century AD. This supports the geomorphological data indicating cleaning operations in the harbour basin. A similar pattern has also been observed at BEY 147 (Curvers and Stuart 2007: 191). Given the close proximity of both sites to BEY 039, these assemblages further support the notion that the features uncovered in BEY 039 were probably active in the Roman period. More specifically, given the lack of material dated to the 2nd-5th centuries AD, it seems likely that dredging operations must have occurred at least after the 1st century AD.

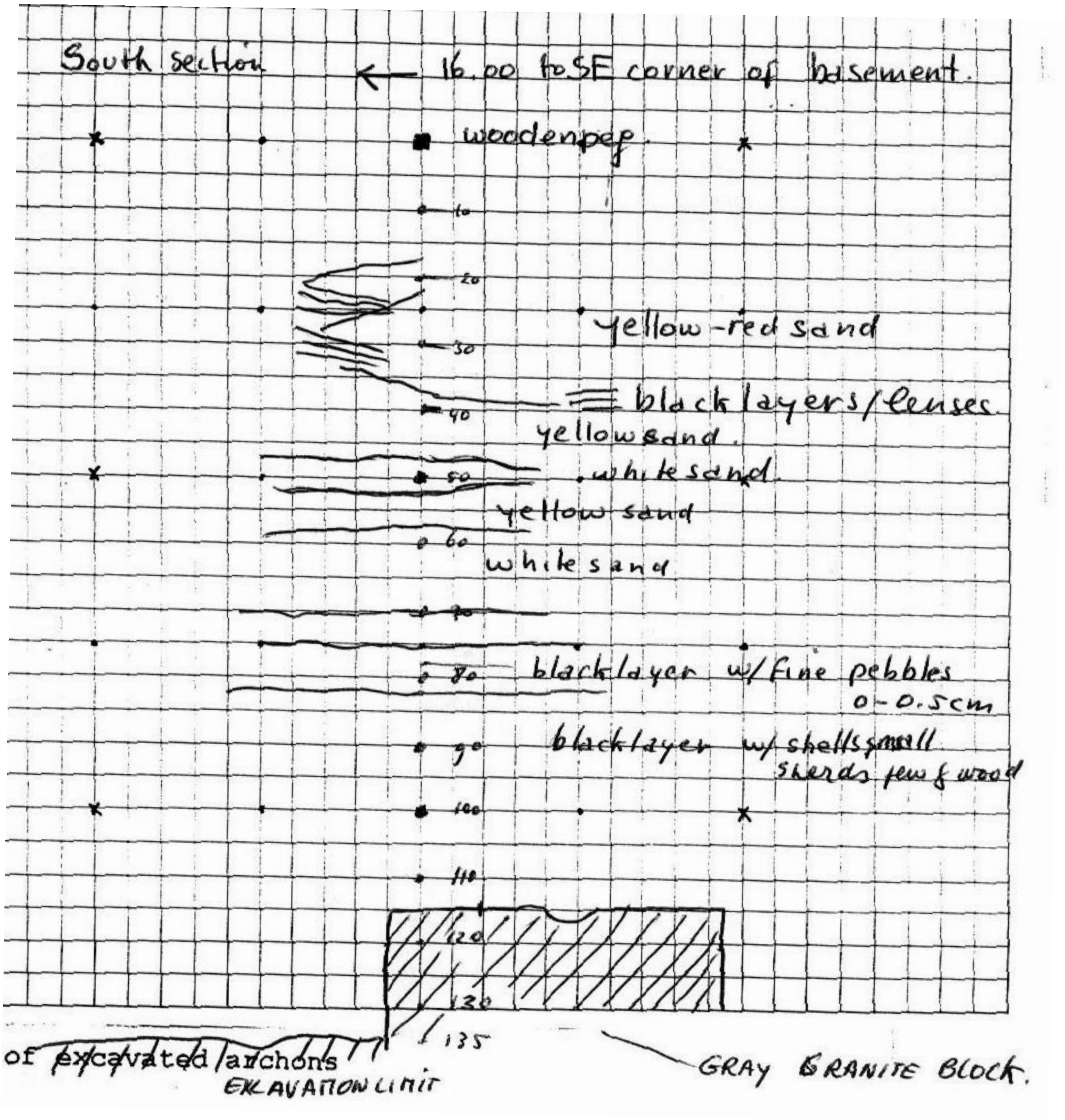

Figure 5.23: Preliminary notes on sediments observed in BEY 143 (unpublished notes provided by Hans Curvers)

5.2.3 **Discussion**

5.2.3.1 Construction and Continuity

An analysis that combines geomorphology, architectural remains and ceramic distributions point to an initial construction date of a quay in the Iron Age (Stratum III of BEY 039), with refurbishment in the Hellenistic period and later in the Roman period (Strata I and II of BEY 039, possibly related to BEY 007). This harbour basin is located between Burj al-Mina and the installations of BEY 007, encompassing an area of roughly 50,000 to 70,000 m^2, with a depth in the Roman period of 2-3m. Unfortunately, the lack of sedimentary cores adjacent to BEY 007 complicates our understanding of the features observed. However, given the similarities between SWP1 of BEY 007 and Stratum I of BEY 039 (use of mortar, size of ashlar blocks, rough alignment), they are likely from the same quay. Furthermore, the preliminary observations regarding BEY 147, which lies adjacent to SWP1, and BEY 143, adjacent to BEY 039, corroborate geomorphological propositions of activity and upkeep in the form of dredging in the Roman period. Given this proposition, the Roman coastline proposed by the author in this chapter (see Figure 5.5) is largely based on the work of Marriner et al. (2008), as well as the research of Davie (1987), but adapted according to this interpretation. As discussed earlier, the author suggests the coastline in the Roman period to have followed the installation uncovered in BEY 007 (as it appears that the feature can be tentatively dated to the Roman period), as well as the quay in BEY 039 (given that Stratum I appears to be a refurbishment in the early Roman period).

5.2.3.2 Wider Comparison

In relation to other Roman Levantine ports, such as Akko, Sidon and Tyre, Beirut is quite comparable in both the estimated area and depth of the harbour basin in the Imperial period (Table 5.1). Caesarea stands out based on these variables, with a larger harbour characterised by two basins, totalling roughly 200,000 m^2, and reaching up to 4m in depth (Brandon 1996: 34; Raban 1989: 288). These sites are all generally characterised by a well-maintained harbour during this period, followed by the slow accumulation of sediments in the Byzantine or Early Islamic periods, resulting in the depth decreasing, sometimes resulting in the harbour eventually being buried (Carayon et al. 2011; Galili, Rosen, Stern et al. 2007: 68; Marriner et al. 2006).

Site	Harbour Area (m^2)	Depth (Imperial period)	Notes	Source
Akko	50,000?	2.5m		Galili, Rosen, Stern et al. 2007; Galili et al. 2010
Beirut	50,000-70,000?	2-3m	Area unclear, but measured from north-western edge of proposed basin to Burj al-Mina	Carayon et al. 2011
Caesarea	200,000	>2m inner harbour, 3.5-4m outer harbour		Brandon 1996: 34; Raban 1989: 288
Carthage	250,000	>2m		Hurst 2010; Hurst and Stager 1978: 341-42
Elaia	>50,000	3m	Closed basin is 50,000m^2, but multiple harbours and open harbours make this figure a drastic underestimation	Seeliger 2016: 16
Ephesus	200,000	5m		Delile et al. 2015

Fréjus	100,000-120,000	7-8m	Depth is 4m in outer part of harbour, indicating high level of upkeep inside main basin	Bony et al. 2011
Ierapetra	40,000	1.5-5m outer basin, 1.5m inner basin		Mourtzas and Kolaiti 2017
Neapolis (Napoli)	?	4m		Delile et al. 2016: 94
Portus	2,330,000	6-8m	Area calculated for all harbour basins comprehensively	Salomon et al. 2016
Sidon	50,000?	2-3m	Area is underestimated	Marriner et al. 2006
Tyre	100,000?	3m	Area is underestimated	Marriner and Morhange 2006

Table 5.1: A comparison of Roman ports in terms of area and depth of the harbour basin(s); data compiled from sources listed or calculated based on maps provided in publications; calculated area encompasses all known harbour basins at each urban site

The larger, monumental port cities of the Roman Empire, such as Portus, Carthage, Ephesus and Fréjus, are significantly larger and deeper than the aforementioned sites (apart from Caesarea). This pattern is significant in the capacity of these harbours to accommodate large ships with deep draughts. While a harbour with a depth around 3m could generally accommodate most merchant ships, certain vessels carrying heavy cargoes could reach draughts of possibly more than 4m (Boetto 2010; Wilson 2011b: 49; Wilson et al. 2012: 379). This indicates that *Berytus* was able to receive most types of ships, but probably did not shelter the largest merchant vessels (Wilson 2011b: 40). Furthermore, the similarities in the depths of Levantine harbours indicates that they all were able to receive a similar range of vessels, generally with a draught less than 3m, though the capacity in terms of area varies from port to port, and cannot be reliably utilised as a reflection of docking space.

5.3 The Urban Centre

To help contextualise the evidence presented in the previous section, it is necessary to explore the urban centre itself to better understand port-related activities in the Roman city. The layout of the city is quite revealing particularly in the retention of certain parts of the original city grid, and the establishment of new plans in other parts. Overall analyses have been undertaken in the past for the Iron Age and Hellenistic periods (Curvers 2002; Elayi and Sayegh 2000) as well as the Roman period (Perring et al. 2003). However, no previous works have assessed the urban centre as a port city, specifically in the urban organisation of *Berytus* in relation to the harbour. This section does so, taking into account the angle of orientation in relation to the port and coastline and how this may have changed over time.

The main excavated areas west of the ancient harbour basin are BEY 006, BEY 007 and BEY 010/039. Certain sites in the western quarter were either not explored in great detail or remain unpublished (BEY 011, 021, 116, 118; Figure 5.25). More specifically, BEY 011 and 021 remain unpublished, while BEY 118 revealed results quite similar to those of BEY 010. BEY 116 is characterised by several small soundings that did not uncover any archaeological remains except for one that revealed the extension of remains in BEY 118 to the north (Curvers and Stuart 1998-99: 18-20). These sites will not be explored in detail since much of the evidence is closely related to BEY 006, BEY 007 and BEY 010/039 (which are better-published sites). South of the ancient harbour basin lies the ancient city centre; the well-published sites are BEY 004, 009 and 045, which revealed extensive remains from the Roman period. While it is outside the scope of this section to discuss urban developments in detail, these sites will be examined in terms of the general nature of this section of the city, its transition from a Hellenistic site to a Roman city and its relation to the harbour.

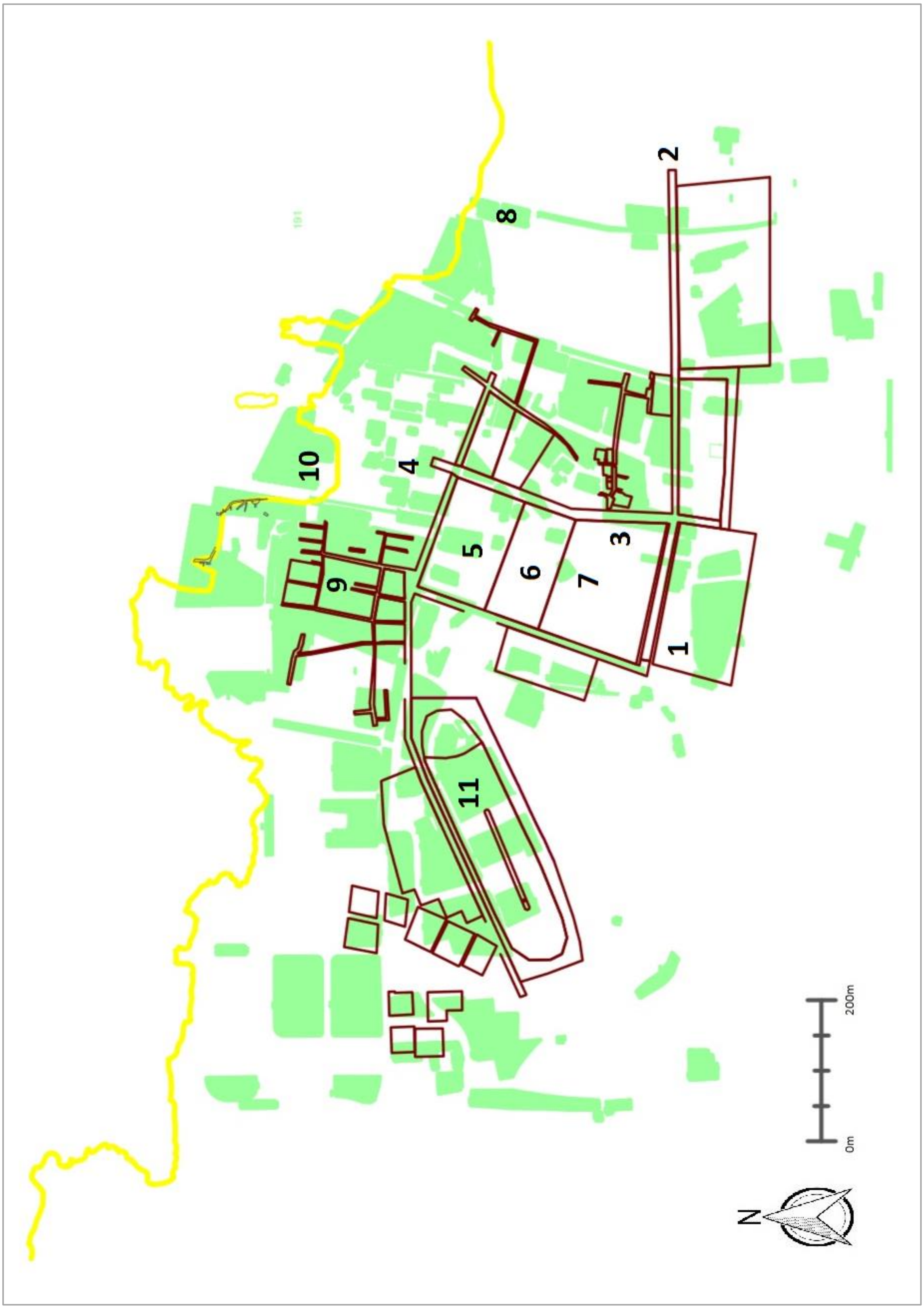

Figure 5.24*:* Proposed Roman street grid of Beirut based on recent excavations; Decumanus Maximus West (1) and East (2), Cardo Maximus South (3) and North (4); Imperial Thermae, BEY 045 (5); Central Forum, BEY 009 (6); Temple and large, domestic dwellings, BEY 004 (7); Roman amphora kilns, BEY 015 (8); Souks area (9); Harbour basin (10); Hippodrome (11) (data provided by Hans Curvers)

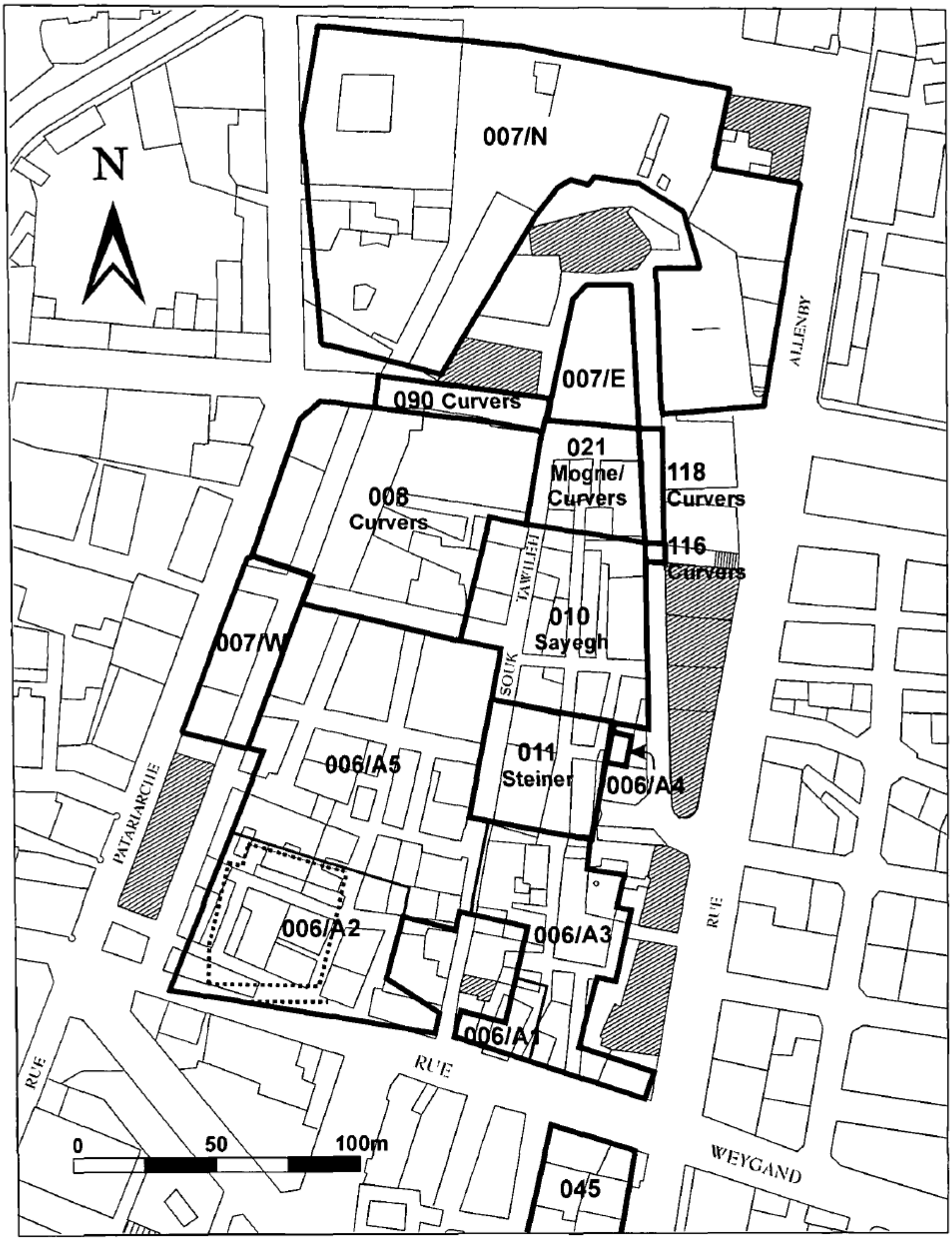

Figure 5.25*:* Sites located at the western edge of the ancient harbour basin (north of the Souks area), with a Roman insula (House of the Fountains) outlined with the dotted line (after Perring et al. 2003: 197, Fig. 1)

5.3.1 **The Urban Grid**

The centre of the city lies south and southwest of the ancient harbour basin. Throughout the 1st century AD, a series of public buildings were laid out around the public squares of the city, and several monumental structures were erected around the forum. These include a basilica, a temple, and two bath-houses at the northern and western margins of the public area (Asmar 1998; Lauffray 1945; Marquis and Tarrazi 1996; Perring et al. 2003: 200-1; Thorpe 1998). This area is located near the modern-day Parliament buildings of Beirut (just north of BEY 009). This evidence is mentioned here because epigraphic sources state Hellenistic Beirut to have had both an agora and a temple dedicated to Astarte (Beyhum et al. 1997; Lauffray 1977: 141; Perring et al. 2003: 200; Sader 1998: 32), though these have not been identified through the BCD excavations. Thus, we are left to hypothesise as to the location of these older public structures. It is tempting to suggest that the grandiose public buildings constructed after Roman colonisation were situated on top of the former Hellenistic centre without a significant reorganisation of the city, though we must remember this is not corroborated by any physical evidence.

The orientation of the 'Souks' area appears to be aligned with the Roman baths and forum (5 and 6 in Figure 5.24), slightly offset in a northeast-southwest direction and running parallel to each other. However, the street grid is far from regular; it appears that the new colonists adopted pre-existing street systems that followed the natural topography of the region, as has been observed at other sites along the Levantine coast (Patrich 2001; Perring et al. 2003: 208). This would not be unusual for a Roman town, as colonies established at existing cities were often not characterised by an orthogonal grid, but rather, inherited existing grid systems in certain parts of the city (Laurence et al. 2011: 136-8; Patrich 2001; Woolf 1998: 10-1). It has been suggested that streets 1 and 2 represent the Decumanus West and East, and streets 3 and 4 represent the Cardo Maximus South and North, respectively, upon which the city grid would have been based (Curvers 2002: 98-9; Curvers and Stuart 2007; Lauffray 1977: 159-60; Saghieh-Beydoun 2005; Saghieh-Beydoun et al. 1998-1999). This claim is supported by the presence of a basilica and a temple at their intersection at BEY 045 and a bit further south at BEY 009 (Saghieh-Beydoun et al. 1998-1999).

The establishment of these monumental structures differentiates a phase of urban development associated with Roman colonisation, corroborated by a rotation of the central axis of the city. More specifically, the southern portion of the Cardo Maximus and the western part of the Decumanus Maximus deviate quite distinctly from the pre-existing Hellenistic grid (Figure 5.26). Thus, in certain parts of the urban centre, city planners for the colony imposed a grid with a new orientation and axis that cut through previous structures, such as the Hellenistic water reservoir (Saghieh-Beydoun 2005: 168). Further north, the Cardo Maximus (4) seems to run parallel to the grid of the north-western quarter of the city at the Souks area. These streets and insulae were built on existing Hellenistic structures, and it appears that the previous Hellenistic city grid was retained to some extent (Aubert 1996; Arnaud et al. 1996; Curvers and Stuart 2007). Some scholars have argued that this was the location of some of the veteran houses (Perring et al. 2003: 207-8). However, this requires an in-depth examination of the material culture in specific dwellings, and a comparison of pre-Roman and Roman phases.

Regardless, this continuation in the existing urban grid supports the analysis regarding the harbour installations discussed earlier. City planners seem to have preserved the entire urban grid from BEY 009 north until the harbour, and the Souks area (Figure 5.24; Curvers and Stuart 2007). This means that they adopted new street grids essentially in every part of the colony except the area encircling the harbour basin. If the street alignment around the harbour was retained after the establishment of *Berytus* as a Roman colony, it seems quite likely that the adjacent quay of BEY 039 would have been refurbished and utilised again in the Roman period.

Figure 5.26: Decumanus Maximus East overlaying Hellenistic structures (after Saghieh-Beydoun 2005: 168, Fig. 33)

The private dwellings around the harbour, specifically in the Souks area, are characterised by peristyles, built-in baths and basins, and multiple peripheral rooms with decorated mosaics (Curvers and Stuart 2007: 215-6). This suggests that the area just west of the harbour was inhabited by wealthier residents. Conversely, the eastern quarter of the city around BEY 015 is characterised by workshops and ceramic kilns, some of which produced the Beirut Type Amphora.

This region also contains storage facilities, presumably related to the adjacent workshops (Curvers and Stuart 2007: 216). This appears to be a stark contrast from previous periods, given that the former Iron Age stronghold was located in the same eastern region (Badre 1997; Finkbeiner and Sader 1997). In this area, specifically BEY 003 and BEY 032 (Figure 5.5), excavations uncovered a stone-paved ramp, characterised as the western edge of the Iron Age fortress (Curvers 2002: Fig. 2, Fig. 4). It has been theorised that the ramp led towards an eastern harbour (near the Bay of Saint André) in a north-western direction (Curvers 2002: 63). A rough date for this ramp and associated features has been established as sometime between 750 and 700 BC (Badre 1997: 76).

This characterisation does not seem to be corroborated by geomorphological studies, which suggest this area of the coast to have been exposed and unprotected (Marriner, Morhange and Beydoun 2008). However, if some sort of loading/unloading area existed for the Iron Age fortress for ships, it was completely transformed in the Roman period into a functional area related to the production and storage of ceramics and glass. This includes the production of Beirut Types 2 and 3 amphorae (Reynolds et al. 2010), presumably also indicating that the vessels would have been filled and stored in this area. Unfortunately, there is currently no published examination of the ceramics uncovered from these storage facilities, and it is unclear whether any imported material was uncovered. However, given the close proximity of the storage area to the workshops in BEY 015, and the fact that the majority of finds appear to be products of the adjacent kilns (Curvers and Stuart 2007: 216), it is reasonable to assume that this area served more as a production site and storage area for local products (as opposed to a storage area for imported goods). The northernmost street running E-W and leading from the Souks area may have extended to BEY 015, and might have provided a direct path from the harbour to these kilns/storage facilities. Furthermore, given the former characterisation of the eastern area as a loading/unloading point in the Iron Age, it is also possible that the proximity of the kilns to this area reflects its continued use as such in the Roman period.

5.3.2 **Expansion of the Urban Centre**

This urban planning also involved an increase in the size of the port city. The physical expansion of the city from the Hellenistic period to the Roman period has been established by the presence of Roman cemeteries at BEY 022 and 163 outside of the Hellenistic city limits (Figure 5.27). Since Roman cemeteries were generally placed at the edge of cities, usually outside city walls (Fischer and Taxel 2007; Laurence et al. 2011; Palli et al. 2016: 11), they can serve as markers for the outer boundaries of the urban centre. Furthermore, the abovementioned sites did not reveal any Hellenistic or earlier foundations, indicating that these cemeteries were established on previously undeveloped land. This expansion probably also reflects an increase in population at the port city associated with the settlement of Roman veterans (Perring et al. 2003).

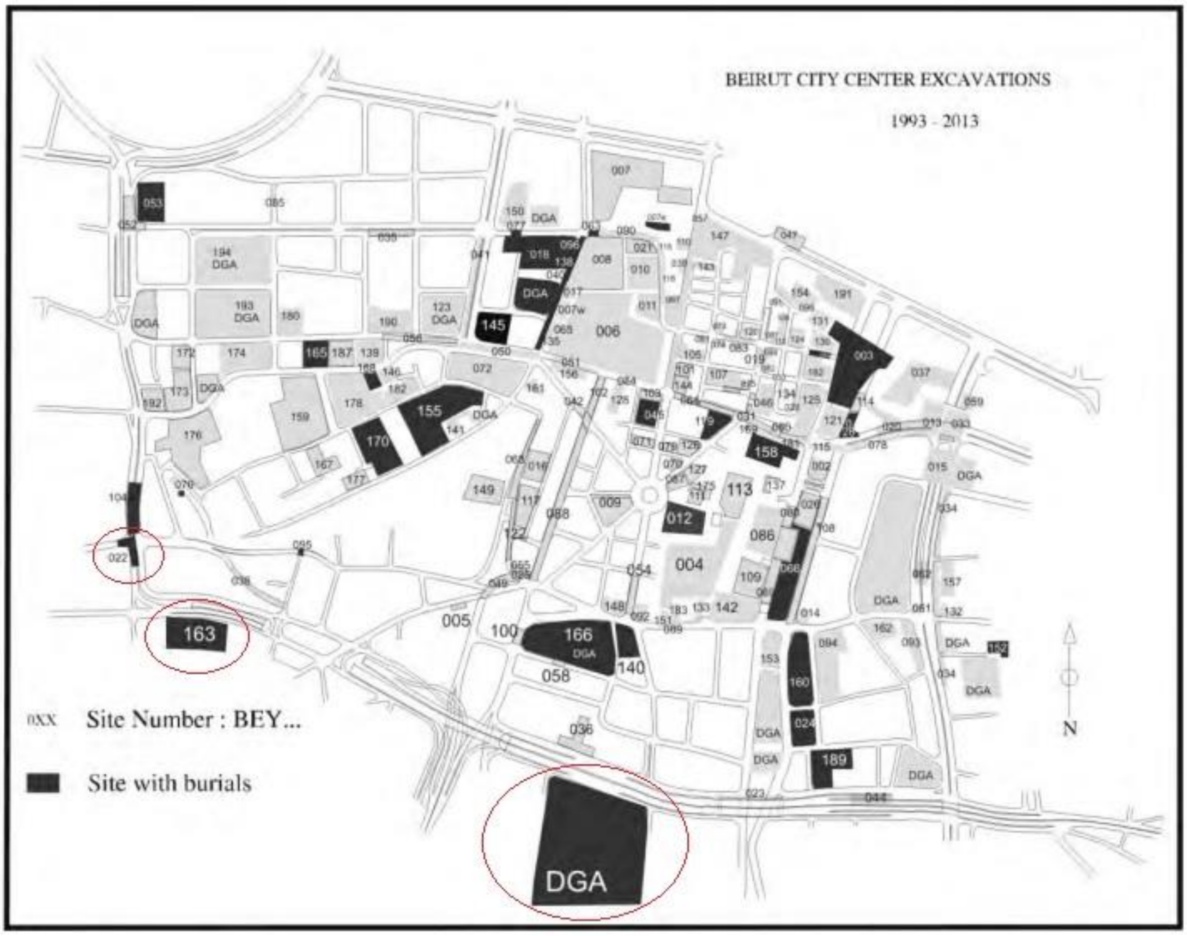

Figure 5.27*:* Burial sites found in excavations at Beirut; 022 and 163 (circled in red) in the southwest represent Roman burials, while 'DGA' represents an area excavated by the Directorate General of Antiquities of Lebanon, also with evidence of Roman burials (after Stuart and Curvers in press: 1, Fig. 1)

Regarding expansion in the western part of the city, the situation is unclear due to the lack of consensus among excavators. At times, it appears that each team arrived at different conclusions regarding the general dating of archaeological remains as well as the overall interpretation of the sequences in BEY 006 (Curvers and Stuart 2007: 194; Elayi and Sayegh 2000: 240-2; Perring et al. 2003: 222). More specifically, Perring et al. (2003) suggest the western edge of the Iron Age city to be located in the centre of BEY 006, perhaps at Souk Tawileh (see Figure 5.25). This is based on differing sequences found east and west of the street, the possibility that there was originally a ditch beneath the street that may have marked the edge of the Iron Age site, and the fact that the mid-2nd century portico had its point of origin here, possibly indicating an important boundary (Perring et al. 2003: 199). However, Elayi and Sayegh have pointed out that pre-Hellenistic structures were found west of the street in BEY 010, Secteur B (Perring et al. 2003: 222). Thus, there is some disagreement about the true western edge of the Iron Age city. While the implications of these developments will not be discussed in great detail in this thesis, they are important in future characterisations, as they detail whether developments west of Souk Tawileh were new Hellenistic or Roman constructions, or built on top of the older Iron Age city.

5.4 Conclusion

Several important points can be definitely drawn from a multi-disciplinary examination of the published material. Firstly, the maritime installations observed in BEY 039 were in use in the Roman period based on the retention of the Hellenistic urban grid in the surrounding region, the sedimentary cores taken from BEY 143 and 147, the preliminary soundings conducted in those sites, and the differentiation of construction sequences between Strata I, II and III in BEY 039. Secondly, Strata I seems to be associated in some way with SWP1 of BEY 007 based on architectural similarities, the use of mortar, their general alignment, and cores Be VIII, IX, and X that indicate some form of dredging to have taken place. Regarding the urban centre, the harbour basin was prioritised in the urban plan of the new Roman colony. The eastern quarter was transformed into a more functional area, which may have been easily accessible from the western harbour. In the southern part of the city (labelled 1, 2, 3, and 7 in Figure 5.24), a new grid was imposed upon the existing Hellenistic plan, clearly observed in the deviation from the previous central axis (Figure 5.26). This further corroborates the prevalence of the harbour in the new plan, and the continued use and refurbishment of existing harbour installations.

Period	**Urban Development**	**Possible Reasons**
c. 200 BC	New streets and houses at borders of Souks, refurbishment and renewal of properties within area of earlier settlement	Seleucid conquest resulting in refurbishment and renewal of city
150-50 BC	Lack of public and private building activity, partial abandonment of some districts	Civil wars from strife in unstable Seleucid Kingdom
50 BC-early-2nd AD	Construction of new buildings (shops and houses), refurbishment of older buildings, construction of several colonnaded streets, introduction of piped water supply	Establishment of the Augustan colonia and arrival of veterans
2nd and 3rd AD	Slow in private and residential building activity, but consistent public construction	Possibly plague from 165 AD; reorganisation of province that

	and refurbishment (baths south of the Souks site, for example)	prioritised Tyre, Sidon, and Baalbek
Mid-4th AD	Huge revival, lavish houses	Reorganisation of Empire with greater focus on eastern Mediterranean

Table 5.2: Sequences of urban development based primarily on BEY 006 (after Perring et al. 2003)

Ultimately, Roman city planners either retained the Hellenistic grid, established a new grid on top of these remains, or built on previously-undeveloped areas. The latter two depict new developments, with the construction of undeveloped areas reflecting an expansion of the city and likely an increase in population (Wilson 2011a: 187). These developments are summarised in Table 5.2 with some brief comments on the wider political geography that might have played a part in phases of urban expansion and recession.

This chapter serves to better understand the harbour of *Berytus* and its development over time. In this thesis, the author utilises Beirut as a nucleus in commercial maritime networks over several different periods. Given that the port was actively utilised and well-kept in the Roman period, and the city seems to be largely based around the harbour, the next step is understanding how production and distribution networks involving Beirut compare to the development of the city itself.

Chapter 6 The Production of Wine and Oil in the Hinterland of Roman Beirut

In the first place, it is not only an art but an important and noble art. It is, as well, a science, which teaches what crops are to be planted in each kind of soil, and what operations are to be carried on, in order that the land may regularly produce the largest crops.

- Varro *De Re Rustica* 1.3

6.1 Introduction

Crucial to understanding the colony's production of wine and oil is the relationship between the wide, fertile plains of the Bekaa region with the port city of *Berytus*. This connection between Beirut and the Bekaa is well-attested (Abou Diwan and Doumit 2016; 2017; Reynolds 2005; Newson 2015; Wicenciak 2016a), but the relationship between the Mount Lebanon Range and Beirut remains ephemeral. Scholars often focus on the religious and symbolic aspects of mountainous sites and settlements in the Bekaa (Aliquot 2015; Newson 2019; Steinsapir 2005), but such prioritisations diminish the rural factor of these areas of Roman Lebanon. It must be recalled that these towns and villages were inhabited by a substantial population, composed of a mix of Roman settlers and local farmers and craftsworkers (Millar 2006: 178; Newson 2015). Furthermore, in discussing *Berytus*, scholars generally focus primarily on the coastal urban centre and its relationship with the Bekaa Valley (Hosek 2012; Paturel 2019). This limits the characterisation of the Mount Lebanon Range as a transit area between Beirut and its hinterland. Thus, there is a definite need to examine the rural hinterland of Roman Lebanon not just through the binary characterisation of a port site and wide, agricultural plains, but also in the vast space between these regions. If the population of this area had an appreciation similar to Varro of the suitability of certain pedogeographies and climates to specific crops, it seems quite likely that a large portion of the Mount Lebanon Range would have been agriculturally exploited in some way.

One of the ways of shedding light on sites in the Mount Lebanon Range in this regard is through tracing archaeological evidence of pressing installations. These data can be taken as markers of wine and/or olive oil production, providing a different way to explore sites in the mountainous hinterland of Beirut. In this section, I begin by proposing a rough demarcation of the colony's territory and outlining all known Roman sites in this region (6.2). I then trace identified pressing installations throughout Lebanon (6.3), and examine the ceramic containers that packaged the majority of the resulting wine and oil within the colony of *Berytus* (6.4). This serves to provide a comprehensive assessment of the rural capacity of its hinterland, specifically regarding viticulture and oleiculture.

6.2 Settlement Patterns in the Hinterland of *Berytus*

The data presented in this chapter can be utilised to suggest possible terrestrial routes based on the topography of the region, and also determine the nature of sites based on the distribution of pressing and crushing installations. The rural space arguably begins on the coastal plain of Beirut itself, as attested by several settlements observed outside the urban centre (Figure 6.1). However, these sites are difficult to characterise. The sites of Jnah (3rd-6th AD) and Borj el Barajneh (Imperial period?), located on the south-western outskirts of the city, are likely the location of Roman villas (Jidejian 1993: 95; Mouterde 1907: 337; Thorpe et al. 2001: 16-7). They are roughly 4-5 km outside the city centre, and located in an area once covered in orchards prior to modern construction (Davie 1987). At the sites at Basta Road, Sin el Fil and Hadath, Roman finds including masonry, ceramics, and coins, were apparently uncovered during modern construction, though they have not been collected or processed in any way (Jidejian 1993; Lauffray 1945: 75; Merhej 1973: 194). Thus, the coastal plain seems to have been settled in some capacity beyond the excavated area at the harbour. This region outside the urban centre might have been occupied by larger landowners involved in agriculture in some capacity (Hall 2001-2002; Perring et al. 2003), though this remains to be seen based on future archaeological work.

Figure 6.1: Roman sites on the coastal plain of Beirut outside the urban centre reflecting the surrounding suburbs

Regarding the wider area, the territorial extent of *Berytus* seems to have included some part of the eastern highlands and a large portion of the Bekaa Valley. According to Strabo, this comprised a significant expansion in the northern Bekaa commissioned by Agrippa, who also added to it 'much of the territory of Massyas (Baalbek), as far as the sources of the Orontes River. These sources are near Mt. Libanus and Paradeisus and the Aegyptian fortress situated in the neighbourhood of the land of the Apameians' (Strabo 16.2.19; Jones 2001). A number of scholars have attempted to delineate this territory more specifically, the latest of which (arguably the most successful) has utilised GIS to compare the distribution of Latin inscriptions (associated with *Berytus*) with that of Greek inscriptions (associated with Sidon) in the Bekaa (Abou Diwan and Doumit 2016). This study has also incorporated the wetlands of the southern Bekaa as an important geographical barrier, which seems to be corroborated by the sporadic presence of Roman sites only on the outskirts of the wetlands (Figure 6.3).

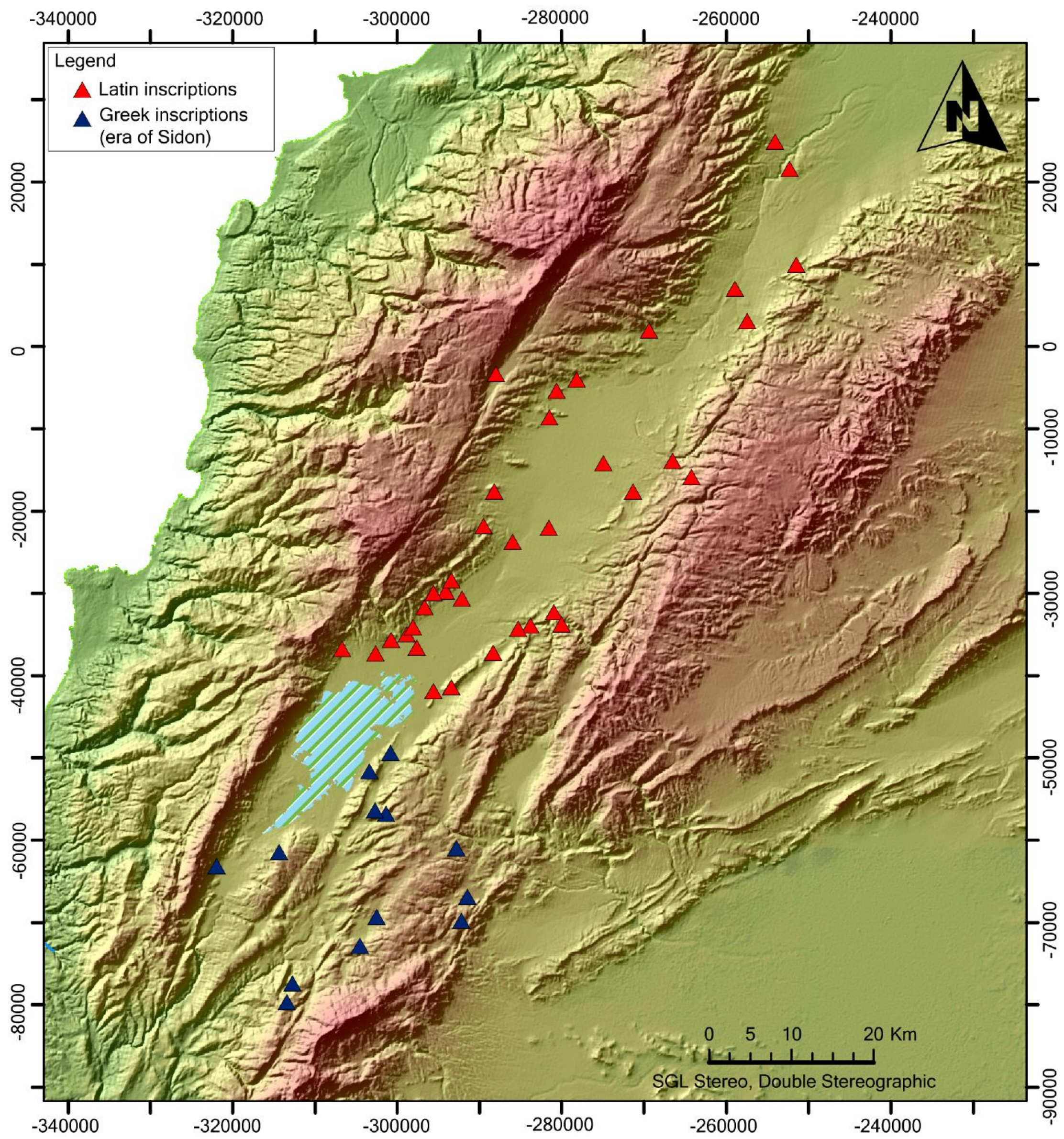

Figure 6.2: Possible demarcation of the territorial extent of *Berytus* before the independence of Baalbek based on the distribution of Latin and Greek inscriptions, as well as the wetland buffer in the southern Bekaa (after Abou Diwan and Doumit 2016: 244, Fig. 21)

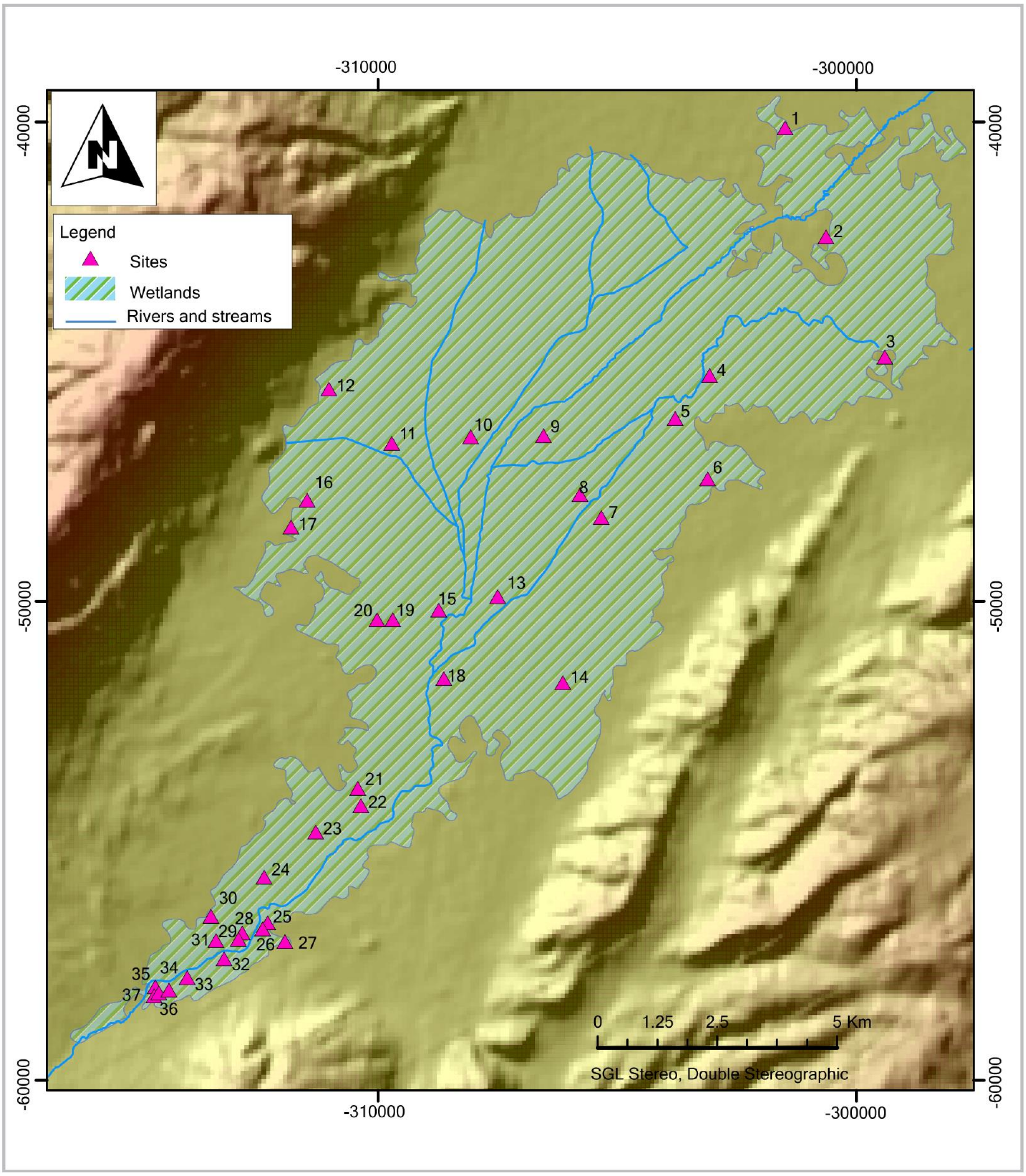

Figure 6.3: Ancient settlements (Neolithic till the Ottoman period) within the wetlands in the southern Bekaa; 1-4, 6-8, 16, and 31 represent sites with evidence of occupation in the Roman period (after Abou Diwan and Doumit 2016: 228, Fig. 14)

Based on these considerations, the territory of *Berytus* has been delineated to the east by the Anti-Lebanon Mountains, south by the wetlands in the Bekaa and north by the region of Laboueh near Nahr el Aassi (origins of the Orontes River, roughly 20 km northeast of Deir el Ahmar; Figure 6.4). However, Deir el Ahmar is the northernmost recorded Roman site within this extent; thus, while the true territorial extent may have been further north, there is no archaeological data to confirm this. The southern limit of the territory is more difficult to ascertain, specifically in the Mount Lebanon Range and on the coast, as reflected by the several conflicting propositions by scholars based on different lines of data. Reynolds suggests Jiyeh to have been incorporated into the territory of the Roman colony based on the production of the Beirut Type 2 amphora at Jiyeh, which is reflective of the centralised control of amphora production within the colony (Reynolds 2005). He argues that the city of Beirut commissioned the production of wine and the Beirut Type to package it, and other regional sites that produced the same type must have been dependent upon Beirut (Reynolds 1999; 2005). Other scholars insist Jiyeh to have remained a part of the territory of Sidon, as attested by the continued use of the Sidonian calendar in various mosaics uncovered in Jiyeh, though these all date to the 5th to 7th centuries AD (Gwiazda 2013: 61; Rey-Coquais 2005: 85). For Gwiazda, this is supported by Polybius, who states the border between Sidon and *Berytus* to have been on the Damour River, which is north of Jiyeh (Polybius 5.68.9; Gwiazda 2013: 61). Given that sources from the Hellenistic period and the Byzantine period suggest Jiyeh to have not been included as a part of the colony of *Berytus*, and the lack of evidence supporting its inclusion within the colony's territory (apart from the production of the Beirut Type 2 amphora which tentatively maintains the assumption of centralised control of all aspects of viticulture and oleiculture within the colony of *Berytus*, discussed further below), the southern limit of the colony of *Berytus* has been specified here around the area of Ain Dara (Figure 6.4). The sites of Bmahrei, Ain Zhalta and Kfar Niss have been listed as possible inclusions, but they may have been better connected with Jiyeh based on the region's topography.

Regarding the northern limit along the coast and in the Mount Lebanon Range, the situation is even more unclear. Unfortunately, the lack of published material from Roman coastal sites and Roman sites in the Mount Lebanon Range north of Beirut prevents any in-depth examination of the subject. For this reason, this section focuses on sites east of Beirut and south of Nahr el Kalb, though the true extent of Beirut's hinterland in the Mount Lebanon Range may have reached the point just south of Nahr Ibrahim. Furthermore, the nature of the relationship between Beirut and Byblos is unclear, though there is no evidence indicating that Byblos was dependent on Beirut in the Roman period in any way.

Site	**Lat.**	**Lon.**	**Type**	**Press**	**Date**	**Notes**	**Source**
Deir el Kalaa	33.8656	35.5953	Rural/Temple	Yes	Roman/Byzantine		Aliquot 2015; Rey-Coquais 1999
Borama	33.8951	35.6451	Temple	?	Roman/Byzantine		Aliquot 2009
Zbeideh Aqueduct	33.8481	35.5596	Aqueduct	?	Roman/Byzantine		Davie et al. 1997

Al Jawzah	33.9270	35.8301	Burials, quarry, large settlement	Yes	Roman/Byzantine		Nacouzi et al. 2004
Majdel Tarchich	33.8951	35.8045	Temple	?	Roman/Byzantine		Aliquot 2009
Sannine	33.9364	35.8414	Temple	?	Roman/Byzantine		Aliquot 2009
Aintoura	33.8852	35.7723	Temple	?	Roman/Byzantine		Aliquot 2009
Ain Dara	33.7813	35.7241	Settlement	No	Roman/Byzantine		Khalil 2015
Bmahrei	33.7566	35.7174	Funerary	No	Roman/Byzantine		Khalil 2015
Ain Zhalta	33.7412	35.7003	Settlement/Fortification?	No	Roman/Byzantine		Khalil 2015
Kfar Niss	33.7384	35.6414	Village	No	Roman/Byzantine		Khalil 2015
Jabal el Knisseh	33.8346	35.7840	Temple	No	Roman/Byzantine		Aliquot 2009
Niha	33.8985	35.9609	Temple, settlement	?	Roman/Byzantine	Frequent reused material throughout modern village	Newson 2015
Hosn Niha	33.9086	35.9462	Temple, settlement	?	Roman/Byzantine	Frequent reused material throughout modern village	Newson 2015
Baalbek	34.0037	36.2107	City	Yes	Roman/Byzantine		Fischer-Genz 2016
Deir el Ahmar	34.1333	36.1333	Agricultural Villa, settlement	Yes	Roman/Byzantine		Salloum 2016
Qob Elias	33.7919	35.8229	Funerary?	No	Roman		Abou Diwan and Doumit 2017
El Qafsiyeh	33.9296	36.2103	Agricultural Settlement	Yes	Roman/Byzantine		Fischer-Genz 2016
Qsarnaba	33.9022	36.0021	Temple	?	Roman		Aliquot 2009
Qalaat Faqra	35.8050	34.0017	Temple, settlement	?	Roman		Newson 2019

Table 6.1: List of recorded Roman sites in the hinterland of *Berytus*

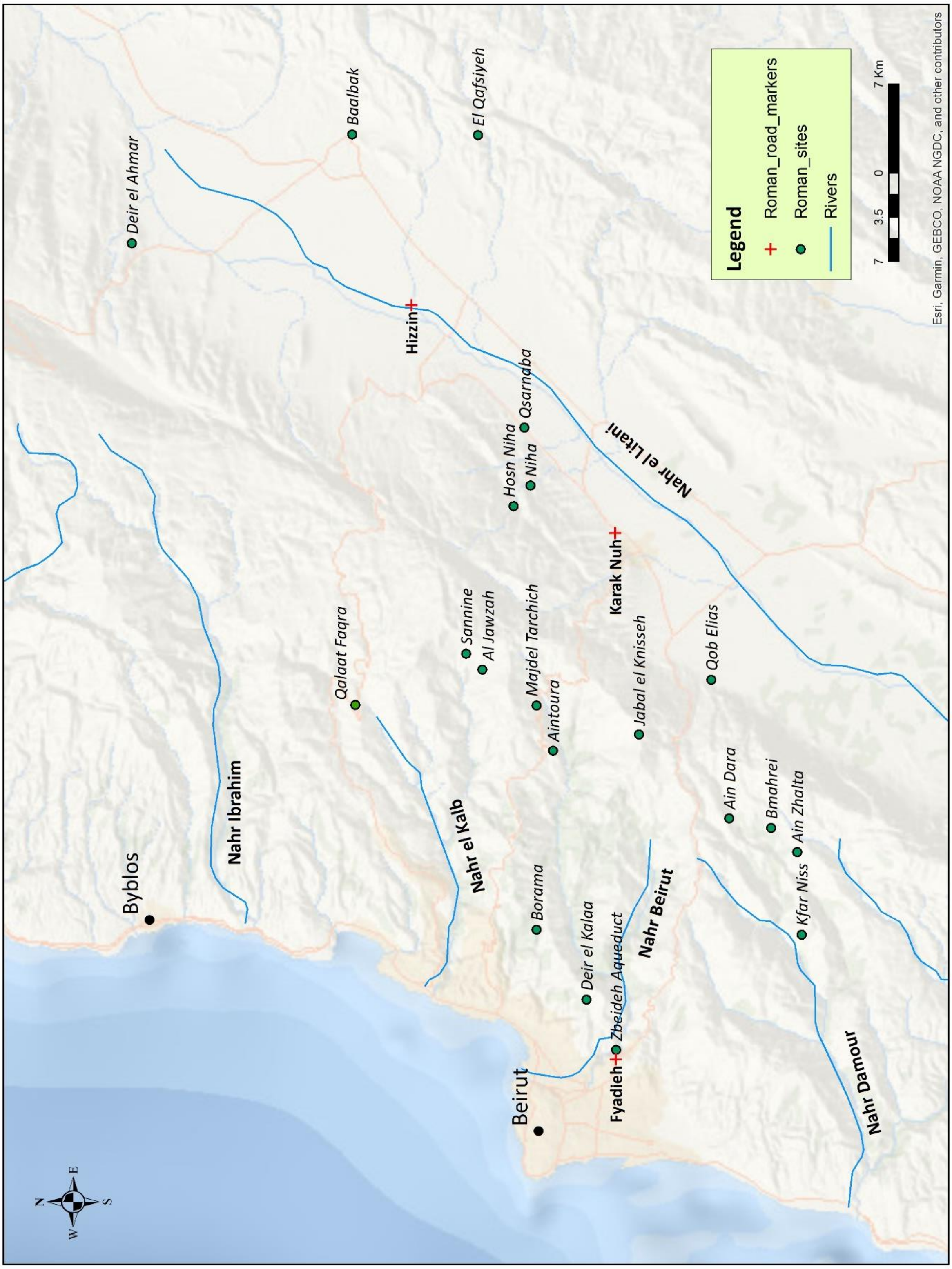

Figure 6.4: Roman sites in the hinterland of *Berytus*; milestones of the Roman road are represented by a red cross; Jiyeh lies south of Nahr Damour, not visible on this map

Within this rough demarcation, 20 distinct rural sites were identified based on evidence of residential dwellings, agricultural activity, or other permanent structures (Figure 6.4 and Table 6.1). Though other inscriptions and scattered archaeological material have been noted at a number of sites throughout the Bekaa (Abou Diwan and Doumit 2017: 237-8, Table 2; Newson

2019: 117, Fig. 1), these data require further examination, and did not necessarily reflect rural settlements. Based on the distribution of sites, two routes can be proposed that connect Beirut with its hinterland (Figure 6.5). These have been established based on different archaeological data that tie sites with Beirut, as well suggested routes based on the topography of the highlands of the northern face overlooking Nahr Beirut. These routes both start with the connection with Deir el Kalaa. This settlement is located 15 km from Beirut and is situated at an elevation of roughly 800m in an EZ 4 area. It was established at a flat, elevated area in the region, with numerous agricultural terraces (Aliquot 2015: 540). This site also lies at a geographically strategic point overlooking the valley of Nahr Beirut and surrounding region. At least two temples were erected in the Imperial period dedicated to *Jupiter Balmarcod*, a variation of local and Roman deities, and Juno, as attested by inscriptions found on-site (Aliquot 2015). One dedication to *Balmarcod* was inscribed for the health of *Quintus Eutychès* by *Marcus Octavius Hilaros* (Aliquot 2015: 549). This dedication proves to be quite crucial in the understanding of the relationship between *Berytus* and *Balmarcodes*, as the Octavii are well-represented in *Berytus* on other inscriptions (Aliquot 2015). Deir el Kalaa's close proximity to Beirut, its ease of access through the mountains and the apparent connection of its citizens with those of *Berytus* all indicate that there must have been some sort of link between each site. Based on the natural topography providing easy access to and from Beirut, it is possible that inhabitants of Deir el Kalaa might have been transporting products to Beirut to sell, or travelling to the urban centre periodically to purchase goods from the market.

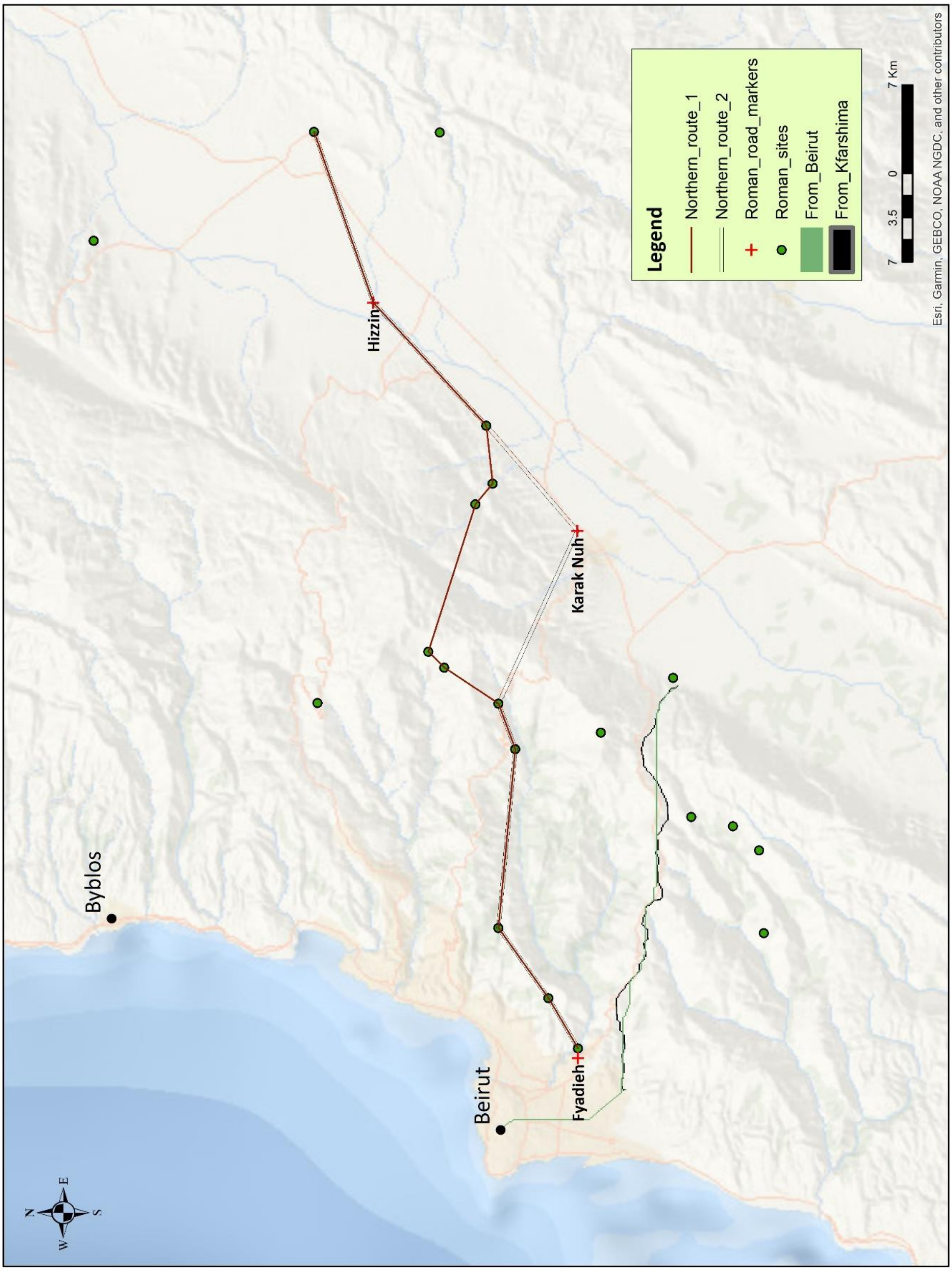

Figure 6.5: Several routes through the hinterland of Beirut; Northern_route_1 and Northern_route_2 represent a hypothesised connection between sites in the Mount Lebanon Range through to the Bekaa, while 'From_Beirut' and 'From_Kfarshima' represent two least-cost routes from the coastal plain (the former from the urban centre and the latter from Kfarshima adjacent to the Mount Lebanon Range) to the Bekaa; though the least-cost calculation output proposes a route through Kfarshima,

the road marker at Fyadieh indicates that this is a likely connection to the southern path as well

The proposed route follows the gentle slope east to *Borama*, the site of a Roman temple, and subsequently to the temples of Aintoura and Majdel Tarchich. At this point, it appears that two paths become possible: one north to the high peaks of Sannine (temple) and the region of Al Jawzah, with several sites dated to the Imperial period (quarry, burials, and main settlement) (Nacouzi et al. 2004), and another possible connection with the Roman road marker observed in Karak Nuh (though this route is quite difficult) (Figure 6.5). A sherd of the Beirut Type 8 amphora was found at Al Jawzah (Nacouzi et al. 2004: 256), suggesting some form of connection with Beirut. However, the subsequent tie between Al Jawzah and Sannine with the Bekaa (Hosn Niha, Niha and Karak Nuh) is tentative, since the terrain is difficult to traverse. Routes experiencing high traffic might have necessitated consistency and a flat slope to support the transportation of goods by pack animals or carts (Adams 2012; Cioffi 2016; Peña 2007: 336). While travelling across steep slopes was definitely possible, as shown in the presence of a possible Roman path along the uneven terrain around Maaser el Chouf (roughly 10km south of Ain Zhalta), it might have served a smaller population and experienced a lower degree of traffic (Khalil 2015: 32). Therefore, it is possible that these two sites, which are located at high altitudes, might have been secluded from the Bekaa Valley, or required a more difficult path travelling north or south to access the easier entrances through the Mount Lebanon Range into the valley. This is also the case for the sites of Aintoura and Majdel Tarchich.

The relative frequency of rural settlements in this region of the Mount Lebanon Range is quite curious considering the contrast with the region around the least-cost route south of Nahr Beirut. This void of Roman settlements in the southern part of the territory might be attributed to the state of research and the lack of publications. Recent work has seen an improvement in this regard. More specifically, Khalil's recent survey of Roman sites in the highlands of the Chouf Mountains (Bmahrei, Ain Zhalta, Ain Dara and Kfar Niss) indicates that there is some evidence of settlement in the Roman period (Khalil 2015). Thus, though the area east and slightly north of Beirut seems to have been more densely settled, it seems likely that the region around the proposed least-cost route might warrant archaeological survey to shed light on a prime location for rural settlement.

In the Bekaa Valley, the key rural sites appear to have been Baalbek, Niha, Hosn Niha and Deir el Ahmar. This is based on the settlement of veterans in Hosn Niha and Baalbek, and the presence of a large temple and burial sites in Niha, likely associated with the settlement in the adjacent site (Hosek 2012; Millar 1990: 19-20; Newson 2015; Newson and Young 2018: 164; Sartre 2001: 646, 706). Furthermore, Baalbek seems to have been producing a substantial quantity of various agricultural products, with a significant specialisation along the western slopes of the Anti-Lebanon Mountains in viticulture (Fischer-Genz 2016). In the region of Deir el Ahmar, a Roman villa was uncovered, along with a temple, a quarry and a number of smaller settlements (Salloum 2016). Given its likely inclusion within the territorial extent of *Berytus*, this region reflects another significant settlement in the northern Bekaa under the new colony's jurisdiction.

6.3 Wine and Oil Presses

As this thesis concerns itself with the productive capacity of these rural sites, it is necessary to shed light on the frequency of pressing installations related to wine and oil in the territory. Having outlined the likely territorial extent of *Berytus*, and highlighted the prevalent rural sites within this region, it is now possible to do this on a regional scale. This section serves to present the distribution of pressing installations in the hinterland of *Berytus* in relation to these settlements, and contextualise the data with the environmental divisions discussed in Chapter 3. This is done by outlining the typology of crushers and presses in the Levant (6.3.1), followed by tracing their distribution in Lebanon with a focus on the territory of *Berytus* (6.3.2). Although the Beirut Type likely transported wine, we cannot eliminate olive oil as another possible product (Woodworth 2011); for this reason, this section discusses both viticulture and oleiculture in the Roman Near East.

6.3.1 Typology

Winemaking is discussed quite frequently by ancient authors, who differentiate between types of wine and discuss the specifications of good vineyards (Col. *De re rustica* 1.6.9; Pliny *HN* 14; Varro *De re rustica* 54.1). Essentially, after grapes were picked, they were generally crushed by foot in wooden containers or squeezed directly in baskets or sacs (Diler 2010: 160). The remaining skins and pulp could then be transported in baskets to a pressing area, where a weighted press would apply enough pressure to extract the remaining juices (Frankel 2016: 552). This juice would flow into large basins, often made of stone, where it would ferment for some time to produce wine. Variations of wine emerged according to the time of harvest, by utilising various combinations of white or purple grapes, or by fermenting for different periods of time (Purcell 1985).

Figure 6.6: A basin for storing liquid after pressing identified in the region of Baalbek, likely associated with wine (after Fischer-Genz 2016: 68, Fig. 12)

The methodology for extracting olive oil was also discussed extensively by a number of authors, with different specifications regarding efficient production (Cato *De agricultura* 64; Col. *De re* *rustica* 12.52.3; Pliny *HN* 15.4.14; Varro *De re rustica* 1.55.5). Prior to pressing, the fruit needed to be crushed. This was originally done using stone tools, and later in larger basins. The major development in the Classical period was the introduction of the round mill for olive pulp preparation. This was first attested from Pindakas on Chios and Olynthos in Greece in the mid-5th to 4th centuries BC, and from Marissa and Umm el-ʻAmed in the Near East from the Hellenistic period (Waliszewski 2014: 118). It is mentioned by Cato as a *trapeta* moved by a donkey (Cato *De agricultura* 20-22). This form was further differentiated as having concave inner walls and a round crushing basin with a flat bottom, as opposed to the *mola olearia*, which were cylindrical crushing stones (Cato *De agricultura* 20-22). It was recognised as a much more efficient method with easier handling and durability, which left olive stones unbroken, leading to a higher quality oil (Varro *De re rustica* 12.52.6). After crushing the olives, they could be transported to the press to be squeezed further, and filtered in some way to separate the oil from the pulpy remnants and water that was sometimes used to aid in the squeezing process (Frankel 2016).

Figure 6.7: A crushing basin for olives found in Anatolia (after Diler 2010: 169, Fig. 32)

Figure 6.8: A press bed from Anatolia, with grooves for the liquid to flow towards a holding basin (after Diler 2010: 165, Fig. 12)

Oil	Wine
Crushing the olives to a mash	Treading the grapes to express most of the must
Pressing the mash to extract the expressed liquid	Pressing the grape skins and stalks (the rape) to extract the remaining must
Separating the lighter oil from the watery lees	Fermentation

Table 6.2: Summary of the processes of wine and olive oil production (after Frankel 2016: 552)

These production sites are recorded in the archaeological record based on the presence of various parts of a pressing installation which are generally made of stone. These are generally either some form of weight, a basin, a press bed, or (only for olive presses) a crushing mechanism (Fischer-Genz 2016; Waliszewski 2014). In the Near East, especially in Lebanon and Syria, the two primary forms of presses that existed throughout history are the lever-and-weight press (Figure 6.9) and the lever-and-screw press (Figure 6.10) (Waliszewski 2014: 119). The former was mastered in the Iron Age in the region, and further perfected in the Hellenistic period. It involves a wooden beam used as a lever, steadied on one side and weighted down on another, with the fruit near the centre of the beam. The weight lowers the beam to apply pressure to the fruit and yield liquid, running into a collection vat, which differed based on the press' function. This was further developed with the implementation of a screw above the pressing point that could be lowered to apply pressure to the fruit, developed sometime between the 1st century BC to the 1st century AD (Vitruvius *De Arch.* 6.6.3).

The other major form of oil and wine presses is known as the lever-and-drum press, which involves the application of a windlass to lower the beam, either attached to weights or to the beam itself (Vitruvius *De Arch.* 6.6.3; Frankel 2016: 559-60; Waliszewski 2014: 119). This can be supplemented by further weights, or limited solely to the drum to apply the required force upon the fruit. The lever-and-drum press is commonly utilised in North Africa and generally in the western Mediterranean, but also in the Roman Near East, though it has not been observed frequently in Lebanon (Waliszewski 2014: 119).

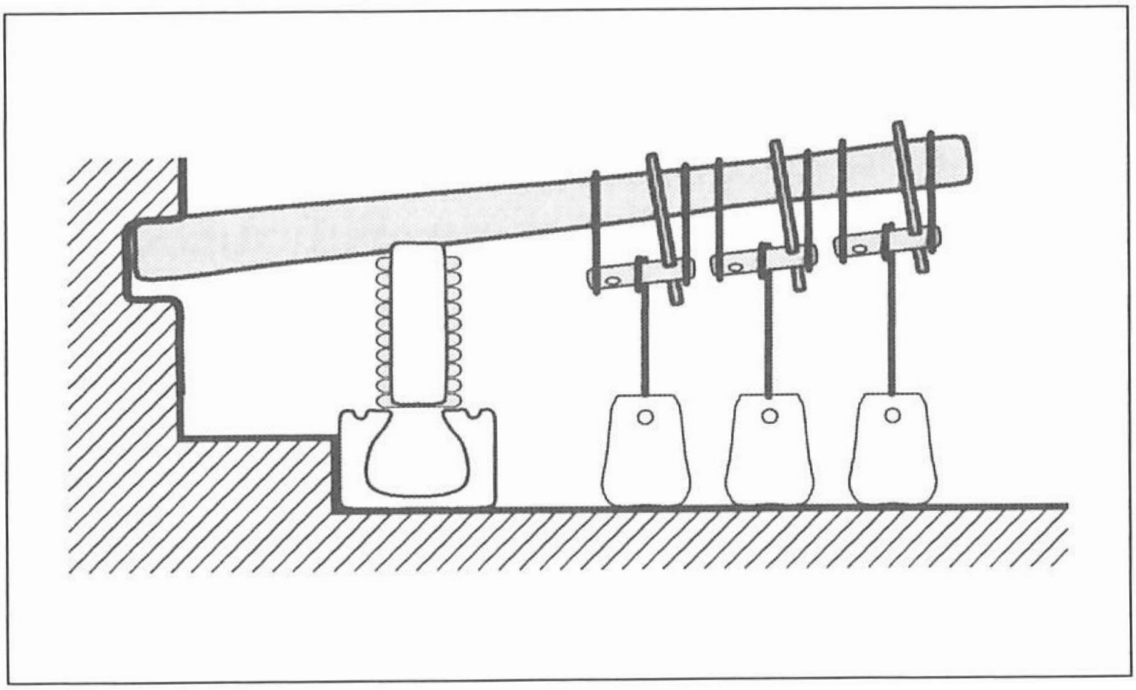

Figure 6.9: Lever-and-weight press with a slotted beam, sacs or baskets in the centre to be squeezed into a collection vat below, and weights attached on the opposing end (after Waliszewski 2014: 135, Fig. 3.4)

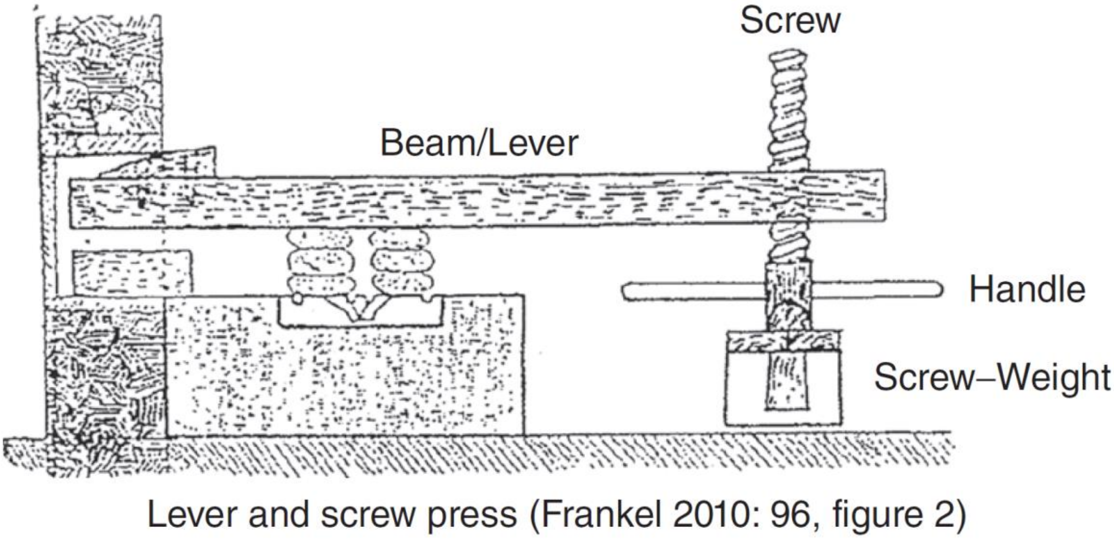

Figure 6.10: Lever-and-screw press with a slotted beam, differentiated from the lever-and-weight press with the presence of a weighted screw, tightened with a handle to exert pressure on the fruit beneath the fulcrum (after Frankel 2010: 96, Fig. 2)

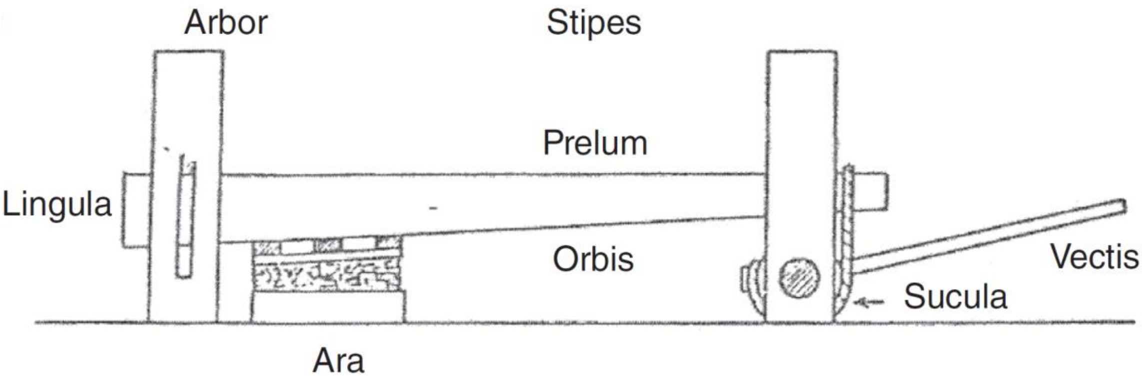

Figure 6.11: Lever-and-drum press as described by Cato, differentiated from the lever-and-weight press by the windlass (*vectis*) (after Cato *De agricultura* 18-19; Frankel 1999: 86, Fig. 8)

These general types have been further organised into a number of sub-types (Frankel 1999; Waliszewski 2014), but it is still difficult to associate specific types with either time periods or function. This has led to conflicting opinions among experts regarding the attribution of certain installations to viticulture or oleiculture, or the association of various types with a specific region or time period (Aydinoğlu 2010: 3; Fischer-Genz 2016; Frankel 2016: 558). Although the common assumption is that old technologies are generally replaced by the new, and progress is an inevitable consequence of the drive for efficiency, in many cases a specific technology fulfilled the requirements of the user and did not warrant change. After the development of the lever-and-screw press and its implementation at a number of sites throughout the Levant, no major technological change ensued, and many of the sites continued to be utilised even up to the twentieth century (Fischer-Genz 2016: 59). The development of the lever-and-screw press did not result in widespread adoption and complete disappearance of an 'inferior' technology. In fact, a number of areas appear to have continued using the lever-and-weight system (see below). A similar pattern is attested in North Africa, where the lever-and-screw press was never adopted, and the population continued to utilise the lever-and-drum press (Mattingly 1996: 588-92). Furthermore, although the lever-and-screw press is easier and safer to use, the system actually exerts less pressure than the lever-and-weight system (Waliszewski 2014: 139-40). This brings up the issue of how exactly technological improvement should be measured (Wilson 2002). This problem is further exacerbated by the fact that archaeological evidence of installations is often fragmentary, with only a press weight or crushing device being found.

Another issue in the study of ancient pressing installations is the difficulty in differentiating wine presses from olive presses. The production of wine involves different initial steps, with pressing often described as an optional phase (Frankel 2016). One possible distinguishing factor is the fact that the volume of liquid stored by wine press sites is usually much higher than that of olive presses. Thus, huge storage vats found in context with a press can be indicative of a wine press (though this is not an entirely reliable factor). Olive presses also often have filtration systems in post-processing, a feature that would generally not be present at a wine press. There is also the possibility of regional uniformity, possibly attested in certain areas of the Levant (Frankel 2016). In parts of the southern Levant, for example, wine presses were composed exclusively of lever-and-screw presses, and designed in a similar fashion (Ayalon 1984; Waliszewski 2014: 139-41). This cohesion suggests that other pressing installations of the same type found in the local region might be associated as wine presses.

One of the key differences between olive oil and wine presses that archaeologists stress is the presence of a press bed for olive oil and a treading floor for wine production (Aydinoğlu 2010: 3; Diler 2010 146; Frankel 2009: 2-3; 2016: 558), but such features are not always uncovered. This differentiation is also not always consistent, especially since terminologies are quite fluid and what may be considered a pressing bed in a publication could refer to a wine or oil press (Fischer Genz 2016: 62). Moreover, the differentiation between olive oil and wine presses proves to be quite difficult due to the persistence of uniform technologies for long periods of time along with the reuse of installations in later periods.

Arguably the most reasonable differentiation is given by Frankel, who states that 'the main difference is that most of the liquid is extracted in the first stage in the production of wine, but in the second in the production of oil' (Frankel 2016: 553). However, the practical application of this principle seems to imply that any press bed uncovered is probably an oil press, though this is not certain. Such a distinction is not necessarily sufficient to differentiate between the two functions. One of the clearest differentiations, and the one that is prioritised in this thesis, is the presence of a crusher, indicative of olive oil production. Grapes, given their softer nature, do not require a crushing method and can either be placed directly for pressing or be crushed in wooden vats by stomping on them (Frankel 2016: 552).

6.3.2 The Distribution of Presses in Lebanon

The points raised in the previous section indicate that typological considerations of olive oil and wine press components must be considered with caution, as they usually do not result in a reliable attribution of date or function. As a result, macro analyses of the olive oil and wine industries in the Near East often group them together as one, further complicated by the issue of ambiguity regarding amphora contents (Peña 2007: 250-71). However, it must be recalled that each industry would have been quite different with regards to the required labour force, tools, production capacity and value (Purcell 1985). For this reason, some preliminary patterns are proposed regarding the distribution of pressing installations in Lebanon, but the characterisations cannot always definitively specify the product or date range of use. When possible, a product is specified in interpretation, but this differentiation has not been undertaken systematically for all presented sites. All identified sites with evidence of wine or olive oil production in Lebanon have been presented below and fully in Appendix C, with the data analysed in more detail in the following sections.

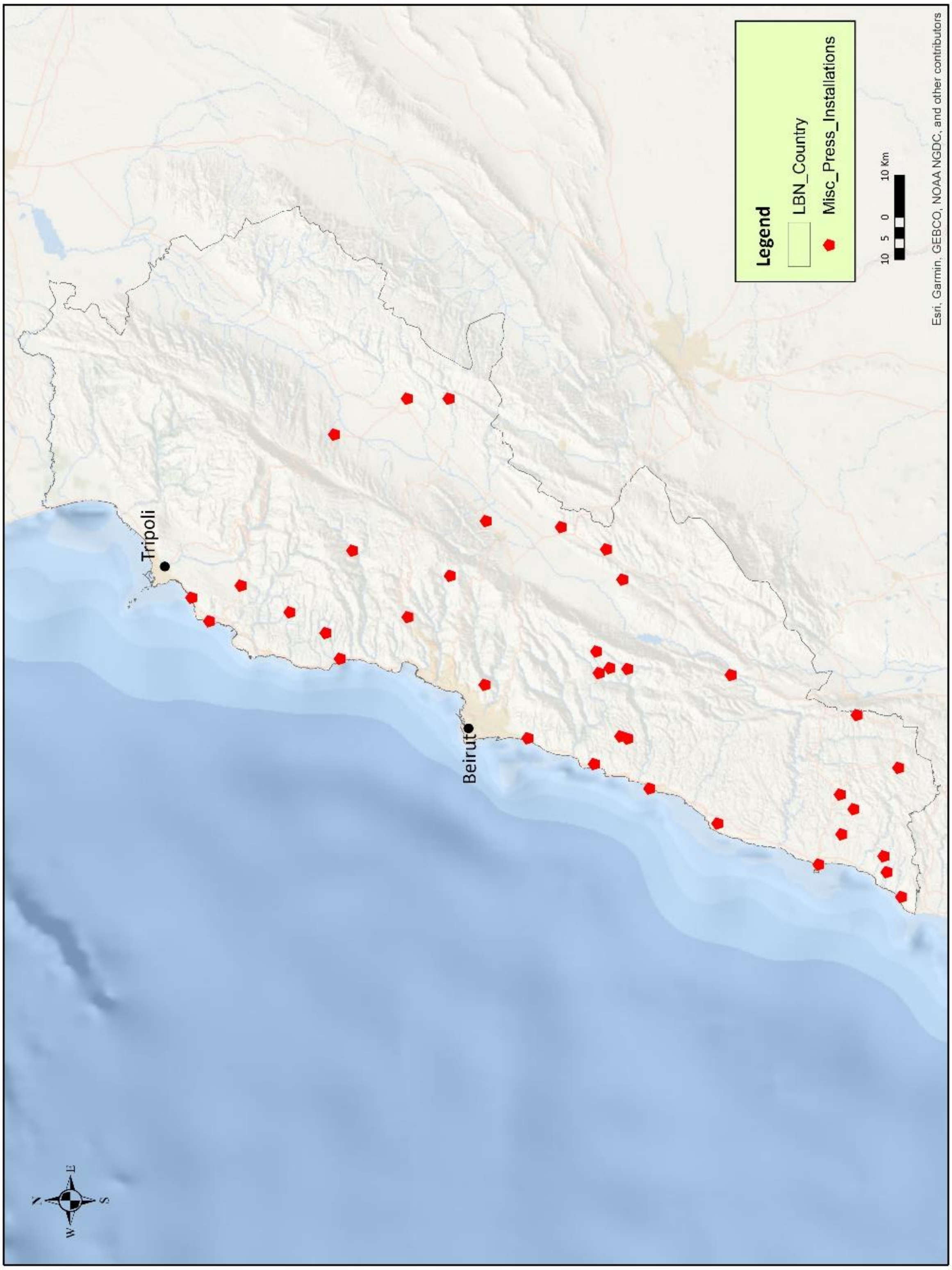

Figure 6.12: Sites with evidence of any type of pressing installation in Lebanon

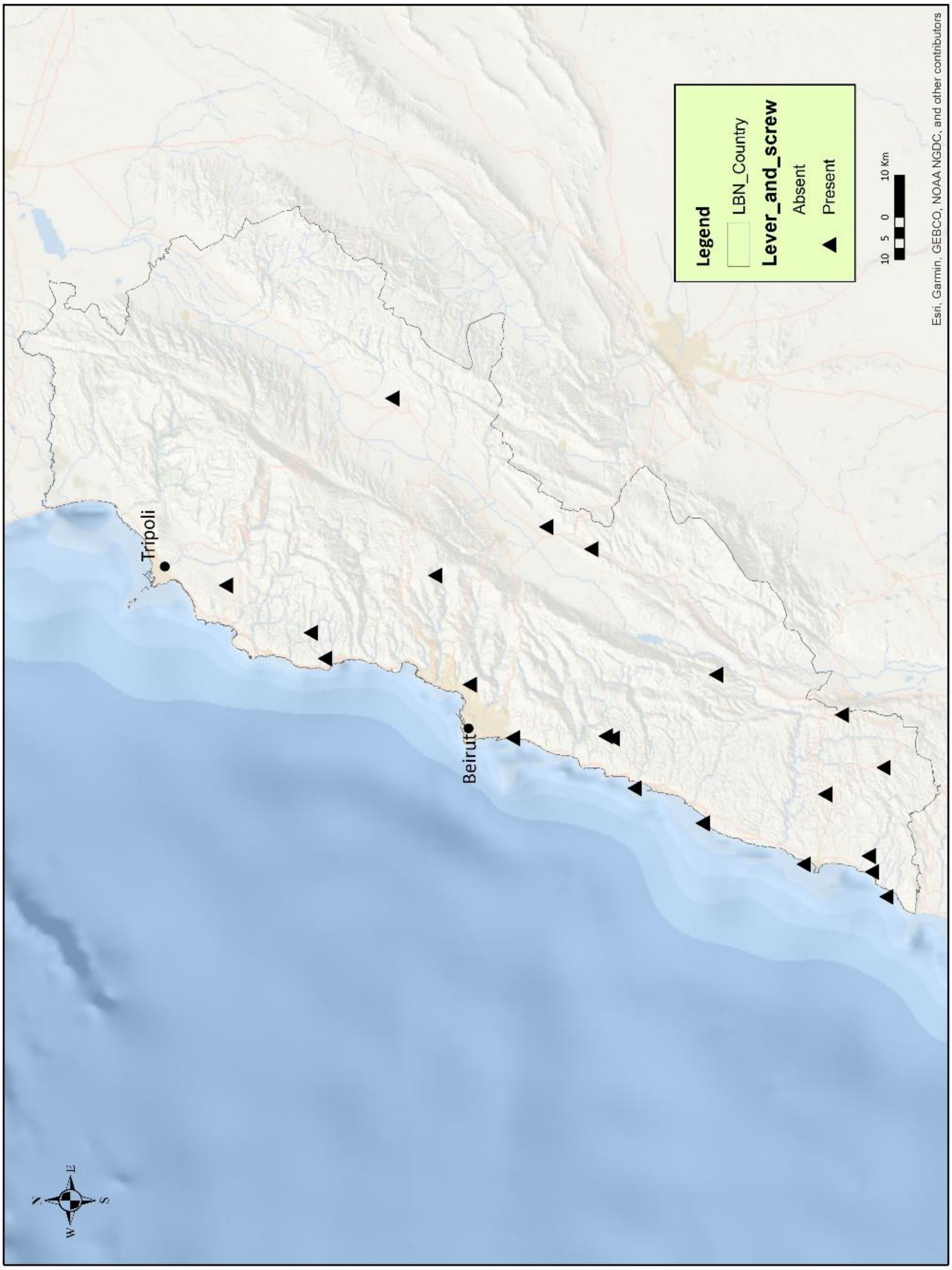

Figure 6.13: Lever-and-screw presses in Lebanon

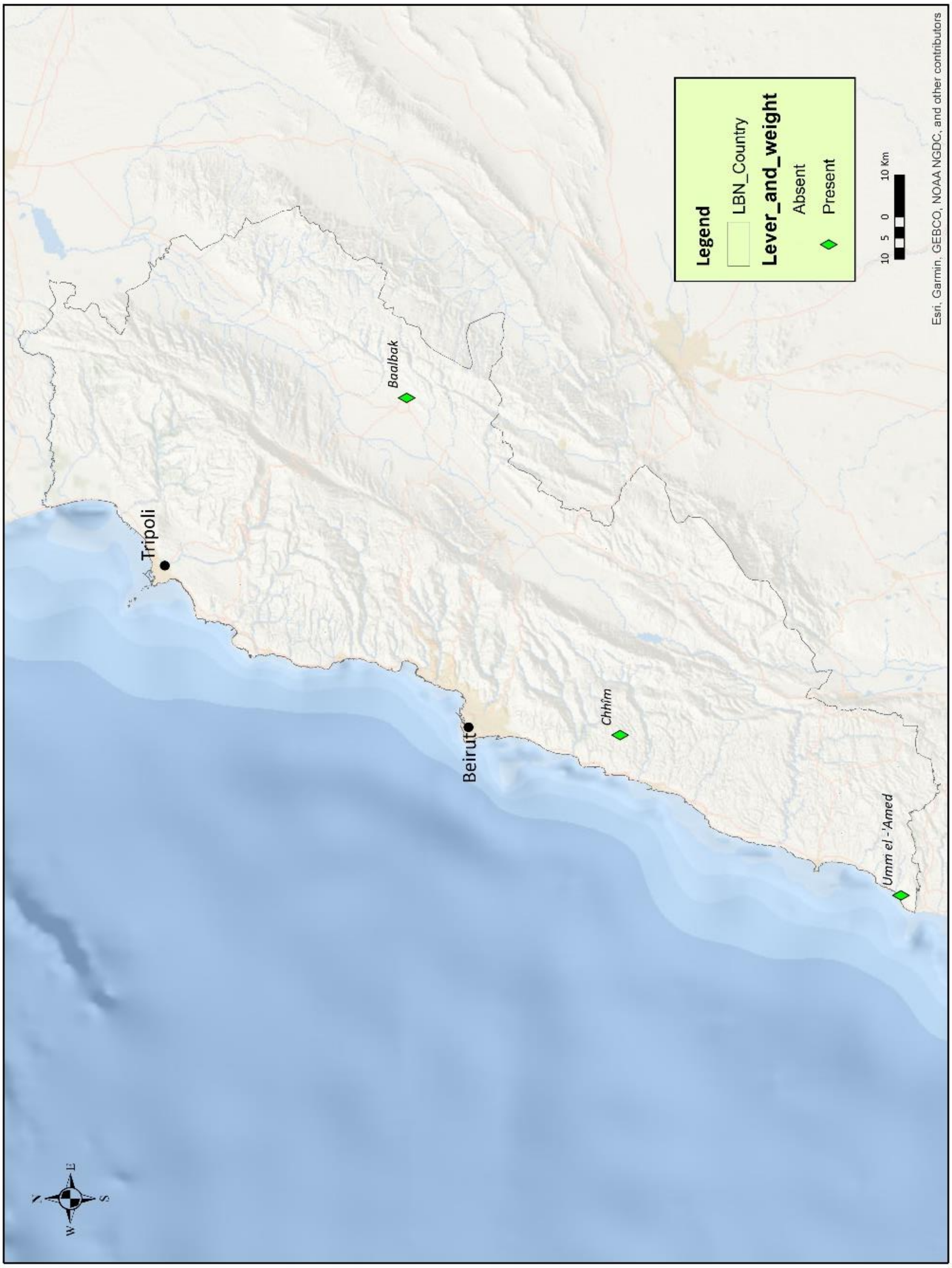

Figure 6.14: Lever-and-weight presses in Lebanon

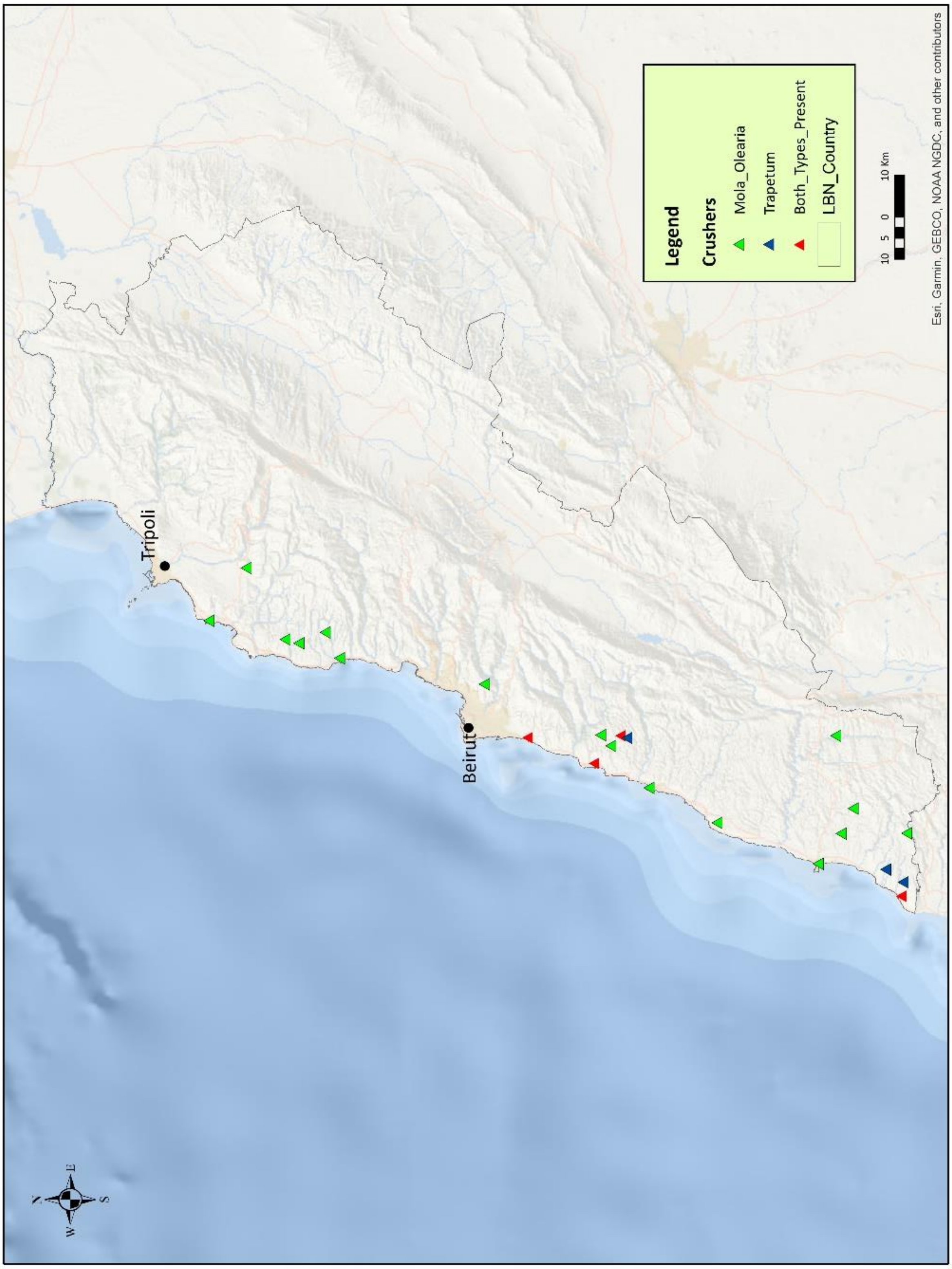

Figure 6.15: Distribution of crushers in Lebanon, indicative of olive oil production

Site	Lat.	Lon.	Zone	Date	Notes	Source
Al Jawzah	33.9270	35.8301	EZ 4	Roman/Byzantine		Nacouzi et al. 2014
Amioun	34.2992	35.8089	EZ 4	Unknown		Waliszewski 2014

Anfeh	34.3555	35.7324	EZ 1	13th-14th AD		Waliszewski 2014
Anjar	33.7291	35.9346	EZ 5	Reuse: Islamic		Waliszewski 2014
Baalbek	34.0037	36.2107	EZ 4/5	Roman/Byzantine	Wine presses	Fischer-Genz 2016
Bahdidat	34.1488	35.7070	EZ 4	Ancient?		Waliszewski 2014
Biyad	33.2048	35.3283	EZ 4	Roman/Byzantine		Waliszewski 2014
Boutmeh	33.6614	35.6210	EZ 4	Roman/Byzantine	Also 'agricultural' installations present	Khalil 2015
Byblos	34.1230	35.6519	EZ 1	Undated		Waliszewski 2014
Chabtine	34.2122	35.7513	EZ 4	Byzantine/medieval?		Waliszewski 2014
Chhîm	33.8736	35.8637	EZ 4	Roman-Byzantine	Mostly oil	Waliszewski 2014
Deir el Kalaa	33.8656	35.5953	EZ 4	Roman/Byzantine?		Waliszewski 2014
El Jouar (Ba'daran)	33.6424	35.6320	EZ 4	Roman/Byzantine	Roman funerary site	Khalil 2015
El Qafsiyeh	33.9296	36.2103	EZ 4	Unknown		Waliszewski 2014
El Qalamoun	34.3865	35.7827	EZ 1	Unknown		Waliszewski 2014
El-Ruweisi	33.1990	35.5306	EZ 4	Undated		Waliszewski 2014
Ferzol (Niha)	33.8633	35.9472	EZ 5	Unknown	Site adjacent to Niha. Originally a tomb and reused as a wine or oil press; probably post-Roman	Newson 2015: 368
Hawarta	33.4250	35.6167	EZ 4	Undated		Waliszewski 2014
Jeba	33.6106	35.6294	EZ 4	Roman/Byzantine	2nd/3rd century to Byzantine pottery	Khalil 2015
Jiyeh	33.6701	35.4253	EZ 1	Roman		Waliszewski 2014
Kamid el Loz	33.6197	35.8217	EZ 5	Roman	Wine press	Fischer-Genz 2016
Khan Khalde	33.7890	35.4807	EZ 1	Roman and Byzantine		Waliszewski 2014
Maaser el Chouf	33.6662	35.6670	EZ 4	Roman/Byzantine	Translates to 'presses of Chouf'	Khalil 2015
Majadel	33.2294	35.3601	EZ 4	Byzantine?		Waliszewski 2014
Majdal Zoun	33.1514	35.2271	EZ 4	Byzantine?		Waliszewski 2014

Mazboud	33.6102	35.4800	EZ 4	Roman-Byzantine		Waliszewski 2014
Qabr Hiram	33.2263	35.2742	EZ 4	Unknown		Waliszewski 2014
Qal'at el-Hosn (Faitroun)	34.0025	35.7414	EZ 5	Byzantine		Waliszewski 2014
Qasr Hammara	33.6484	35.8867	EZ 4/5	Unknown		Waliszewski 2014
Sarafand	33.4490	35.2980	EZ 1	Byzantine?		Waliszewski 2014
Saydet el Borj (Deir el-Ahmar)	34.1333	36.1333	EZ 4	Roman/Byzantine?	Wine press	Salloum 2016
Shal'abun	33.1244	35.4172	EZ 4	Undated		Waliszewski 2014
Sidon	33.5710	35.3729	EZ 1	Roman-Byzantine		Waliszewski 2014
Tallet Irmis	33.1451	35.1935	EZ 4	Undated		Waliszewski 2014
Tyre	33.2680	35.2098	EZ 1	Byzantine/early Islamic?		Waliszewski 2014
Umm el - 'Amed	33.1188	35.1399	EZ 1	Hellenistic		Waliszewski 2014
Yanouh	34.1008	35.8840	EZ 4	7th-8th AD		Waliszewski 2014

Table 6.3: All recorded pressing installations in Lebanon before the Medieval period

Site	**Lat.**	**Lon.**	**Zone**	**Notes**
Anfeh	34.35546	35.73235	EZ 1	
Bahdidat	34.14876	35.70698	EZ 4	
Biyad	33.20477	35.32827	EZ 4	
Borjein	33.65739	35.48638	EZ 4	
Byblos	34.12300	35.65193	EZ 1	
Chhîm	33.87356	35.86375	EZ 4	
Chmis	33.63911	35.46276	EZ 4	
Deir el Kalaa	33.86560	35.59530	EZ 4	
Jiyeh	33.67010	35.42530	EZ 1	
Khan Khalde	33.78900	35.48070	EZ 1	
Ma'ad	34.19566	35.68341	EZ 1	
Marah Umm 'Afiyya	33.11508	35.16981	EZ 1/4	Coordinates approximate, along highlands adjacent to Umm el-'Amed
Marwahin	33.10854	35.27540	EZ 4	
Mazboud	33.61022	35.47996	EZ 4	
Qabr Hiram	33.22630	35.27421	EZ 4	
Qasr Naous	34.28938	35.84571	EZ 4	
Sarafand	33.44900	35.29800	EZ 1	
Shaqif el-Hardon	33.14637	35.19728	EZ 4	Coordinates approximate
Sidon	33.57100	35.37290	EZ 1	

Smar Jbeil	34.21977	35.69194	EZ 1	
Talusa	33.23629	35.48511	EZ 4	
Tyre	33.26800	35.20983	EZ 1	
Umm el-'Amed	33.11883	35.13991	EZ 1	

Table 6.4: All recorded crushing devices in Lebanon before the Medieval period

6.3.2.1 Northern Lebanon

Several areas in northern Lebanon can be characterised as regions with a high density of recorded archaeological evidence for pressing installations: Anfeh, Batroun (around Smar Jbeil in Figure 6.16), and Byblos. These include lone weights, press beds, treading floors, piers, niches for press beams and crushing basins. At Anfeh, an olive press of the 12th-13th century AD has been identified close to the coast (Fischer-Genz and Nordiguian 2010). Further inland, at Qasr Naous, another oil press, possibly from the Byzantine period, has been identified. Both are of the *mola olearia* type, and the Anfeh press utilised a niche for the press beam, carved into the rock. A press bed was also observed north at El Qalamoun, though it has not been definitively dated, a beam counterweight at Faitroun (Qal'at el-Hosn), a screw weight at Amioun, another press bed at Yanouh (7th-8th AD) and an unidentified press at Chabtine. Anfeh and El Qalamoun are located in an EZ 1 area on the coast, while the inland sites are in an EZ 4 area.

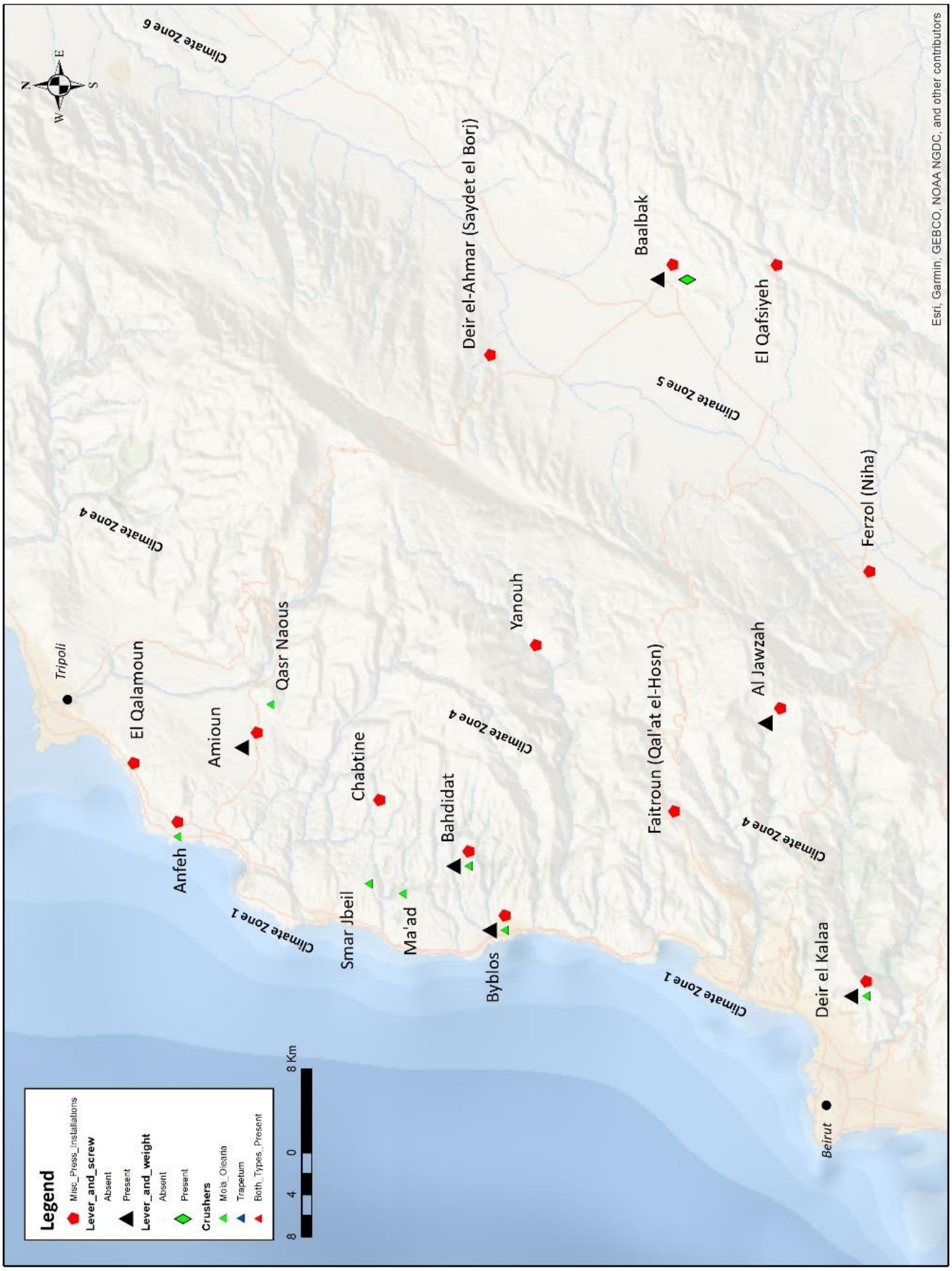

Figure 6.16: Pressing installations in northern Lebanon

Slightly south, in the hinterland of Batroun, at Smar Jbeil and Ma’ad, several undated crushing basins of the *mola olearia* type have been identified in an EZ 4 area. The presence of crushing basins indicates the processing of olives into pulp before subsequent squeezing, clearly differentiating the installations from wine presses. However, the region today is widely-regarded as one of the most prominent wine-production regions in Lebanon. At Byblos, crushing basins of a similar type have been identified as well. A crushing basin was also observed at Bahdidat, in the hinterland of Byblos. Thus, the primary evidence that has been recorded for the coastal region and nearby hinterland of northern Lebanon indicates primarily oil production, though there is a need for more extensive publication to shed light on the region. There is also likely a gap in the data at Tripoli and its hinterland. Since the city was a busy and active port in the Roman period, and the climate is suitable for fruit growing, it seems likely that oil and wine production would have been important industries in the area.

In the Bekaa Valley, a wine press has been identified at the church of Saydet el Borj in Deir el-Ahmar dated roughly to the Roman/Byzantine period. It lies at an elevation of nearly 1100m at the edge of an EZ 4 region. Southeast of the site, a survey of Baalbek has been conducted with more extensive publications, identifying a dense cluster of pressing installations along the western slopes of the Anti-Lebanon Mountain Range (Figure 6.17). In Baalbek itself, two presses have been identified, one of which is associated with suburban Roman *villae* (Chéhab 1957). Carved into the bedrock near Ras el ‘Ain, it is partly constructed with limestone blocks, a common technique for mid-sized pressing installations, and consists of two pressing beds and four rounded basins (Fischer-Genz 2016: 62). In the surrounding region (roughly within 4 km of the main Roman city of Heliopolis/Baalbek), a number of installations were identified, 13 of which were not associated directly with any settlement. This could be suggestive of a differentiation between habitation areas and production areas (Fischer-Genz 2016: 69-70). All remains are rock-cut with some supplementary constructions, and all appear to be lever-and-weight presses, with only the Ras el ‘Ain press being of a lever-and-screw type. These sites are located at the northern limit of EZ 5 and along the western slopes of the Anti-Lebanon Mountains, which can be considered an EZ 4 region, though precipitation levels are lower than the neighbouring Mount Lebanon Range. The identification as either wine or olive presses is still tentative, with only one at El-Qafsiyeh being definitively labelled as an olive press (Fischer-Genz 2016: 62).

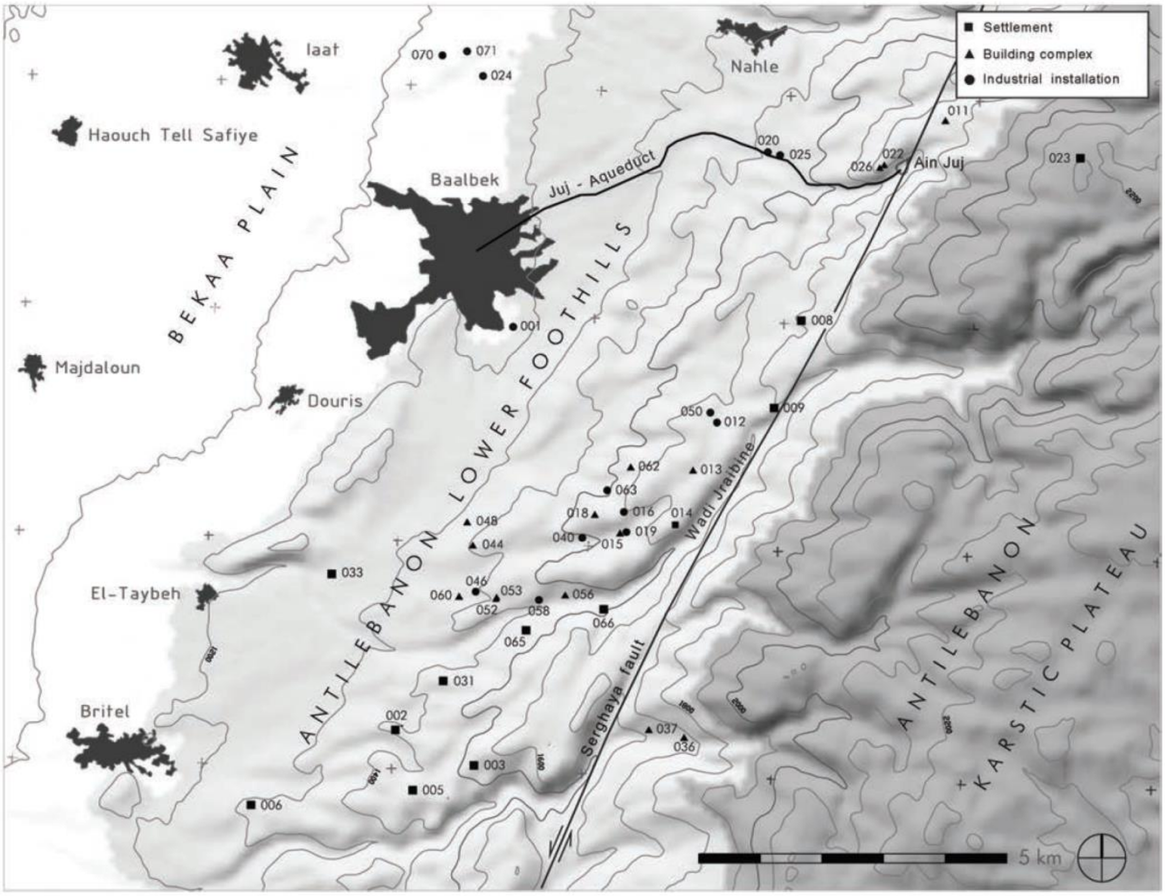

Figure 6.17: Distribution of settlements (squares), pressing installations (circles) and isolated buildings (triangles) in the area of Baalbek (after Fischer-Genz 2016: 59, Fig. 2)

6.3.2.2 Central Lebanon

Further south, in the Zaarour region, a screw weight from the Roman/Byzantine period has been identified in excavations at the site of Al Jawzah (also ‘El Jawze or ‘Ej-Jaouzé’) (Nacouzi et al. 2004: 253). It can be dated roughly to the Roman/Byzantine period, further corroborated by the presence of a possible Beirut Type 8 amphora sherd found at the site (Nacouzi et al. 2004: 256). However, the function of the installation, though it has been specified as an olive press, is not definitively known. Interestingly, Al Jawzah lies at roughly 1400m in elevation, and is located close to the high peaks of Sannine and Zaarour, which are ski resorts today and receive snowfall generally from December/January to March. Thus, although it lies in a EZ 4 region, it is well outside the optimal conditions for growing grapes and olives. This might be reflective of an increasing population in the hinterland of *Berytus*, resulting in the expansion of the population to ‘marginal’ areas.

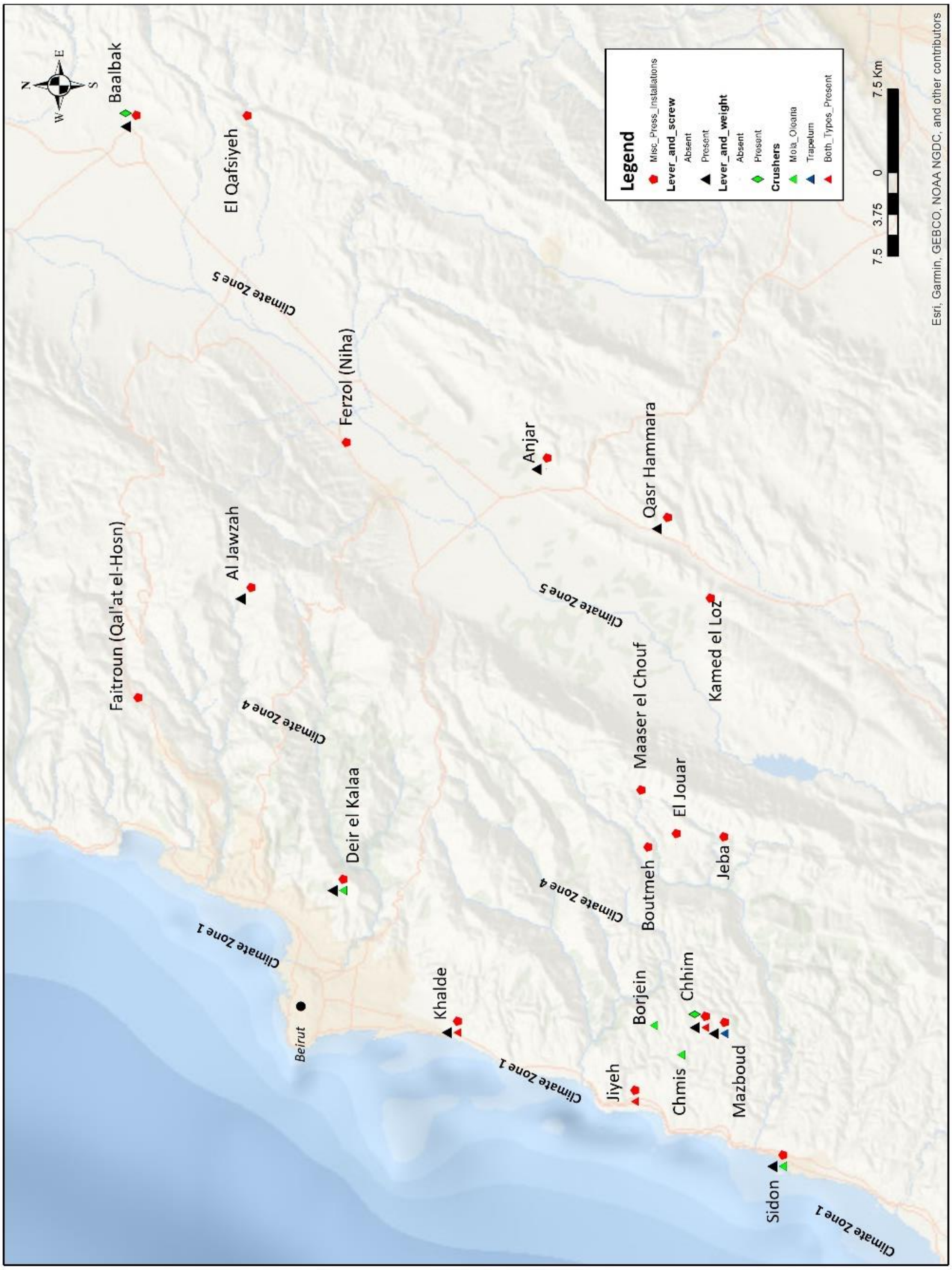

Figure 6.18: Distribution of pressing installations in central Lebanon

Curiously, the central Bekaa is void of installations, apart from one probably dating to the Byzantine period or later (Newson 2015). This is likely due to the lack of fieldwork, as the area is well-suited for vineyards and olive groves. Unfortunately, given the current state of research, it is difficult to establish whether this is due to the agricultural focus of locals on different crops or simply a lack of publication.

Further west, and closer to Beirut, numerous pressing installations have been observed at Deir el Kalaa, a settlement near the modern-day town of Beit Mery, as well as at *Borama* (Brummana) and Mansourieh (personal observation). At Deir el Kalaa (*Balmarcodes*), a number of remains are observed, including crushers of the *mola olearia* type, screw weights and press beds, at least one of which is possibly attributed to a wine press (Nordiguian 1993-1994: 368). Waliszewski attributes these roughly to the Roman/Byzantine period, but there were certainly pressing installations in the Imperial Roman period when considering the dating of the site as a whole. Although the site is often regarded in its religious context (Hosek 2012; Paturel 2019), it seems that it actually also served as a fairly significant production site for wine and olive oil throughout the Roman and Byzantine period. Given its connection with *Berytus* (Aliquot 2015), it is possible that the inhabitants of Deir el Kalaa represent one of the suppliers of wine and oil to be packaged at the urban centre.

South of Beirut, several concentrations of olive and wine presses exist along the coast. The first is observed at Khan Khalde, where beam counterweights have been found in context with lever-and-weights type presses. Additionally, lever-and-screw weights presses have been observed with press beds and screw weights. Although the function of these presses has not been definitively established, it is believed they were used for oil production (Waliszewski 2014: 12). The site of Khan Khalde also produced two variants of the Beirut Type, which is generally believed to have packaged primarily wine (Woodworth 2011: 72). Therefore, it is tempting to propose that some presses uncovered at the site may have been used for wine production, but this cannot be confirmed. However, the presence of both *mola olearia* and *trapetum* style crushing basins indicates that the site is definitely characterised by some degree of olive oil production.

Further south, the site of Jiyeh, dated to the Late Hellenistic and Roman period, has turned up evidence of a lever-and-weights press in the form of beam counterweights and crushing basins of both varieties. Several vats, believed to have been utilised for the grape must, were uncovered in excavations at the site, which were located next to an amphora workshop (Waliszewski and Gwiazda 2015: Fig. 16; Wicenciak 2016b: 78). This workshop is known to have been a production centre of a variant of the Beirut Type in the 1st century AD (Wicenciak 2016a). Thus, it is possible that Jiyeh was producing, packaging and transporting its own product. While no significant harbour installations have been uncovered in the underwater survey of Jiyeh, the density of ceramic finds offshore as well as maritime-related objects such as anchors and fishing gear (Noureddine and Kotlewski 2006), combined with a relatively sandy beach, indicates the maritime region to have probably been active in the Roman and Byzantine period. This might be a good example of an opportunistic port along the coast of Lebanon (4.3.1).

The hinterland of Jiyeh was quite active in the production of wine and olive oil in the Roman period, as attested by the identified press installations at Chhîm, Mazboud, Chmis, Borjein, Boutmeh, El Jouar, Jeba, and Maaser el Chouf. These include lever-and-screw type presses with press beds and screw weights, along with lever-and-weight presses with beam counterweights at Chhîm and Mazboud, one of which produced wine roughly in the 6th century AD (Waliszewski et al. 2002: 40). The majority of the presses uncovered at Chhîm, however, appear to have produced olive oil throughout the Roman and Byzantine periods. The olive oil industry at Chhîm appears to have been fairly longstanding, beginning in the Hellenistic period and continuing throughout the Byzantine period. The village has been described as self-sufficient, suggesting that agricultural production was primarily intended for local consumption (Waliszewski et al. 2002: 53). However, the presence of amphorae from Chhîm at various sites in Lebanon indicates that at least some portion of agricultural products was distributed in the region (Reynolds 2005). Slightly south, exploration of the site of Mazboud has uncovered a number of elements that have been associated with olive oil production, such as beam counterweights for a lever-and-weight press, as well as screw-weights and press beds associated with a lever-and-screw press. This is supported by the variety of crushing devices of both types found at Chhîm, Mazboud, and the nearby sites of Borjein and Chmis.

Further inland, presses dated roughly to the Roman/Byzantine period have been documented at the sites of Boutmeh, Jeba, El Jouar and Maaser el Chouf (Khalil 2015: 30-1). These sites are found on the eastern slopes of the Mount Lebanon Range leading into the Bekaa Valley. Across the Bekaa Valley at Kamid el Loz, a wine pressing installation was uncovered on the nearby slopes, likely dated to the Roman period (Fischer-Genz 2016). However, presses are rarely found in the region, contrasting with the northern Bekaa which saw a number of presses along the slopes of the Anti-Lebanon Mountains and the region around Baalbek. The installation at Kamid el Loz was uncovered in an EZ 4 Zone, which can also be differentiated from the adjacent wide, fertile plains.

6.3.2.3 Southern Lebanon

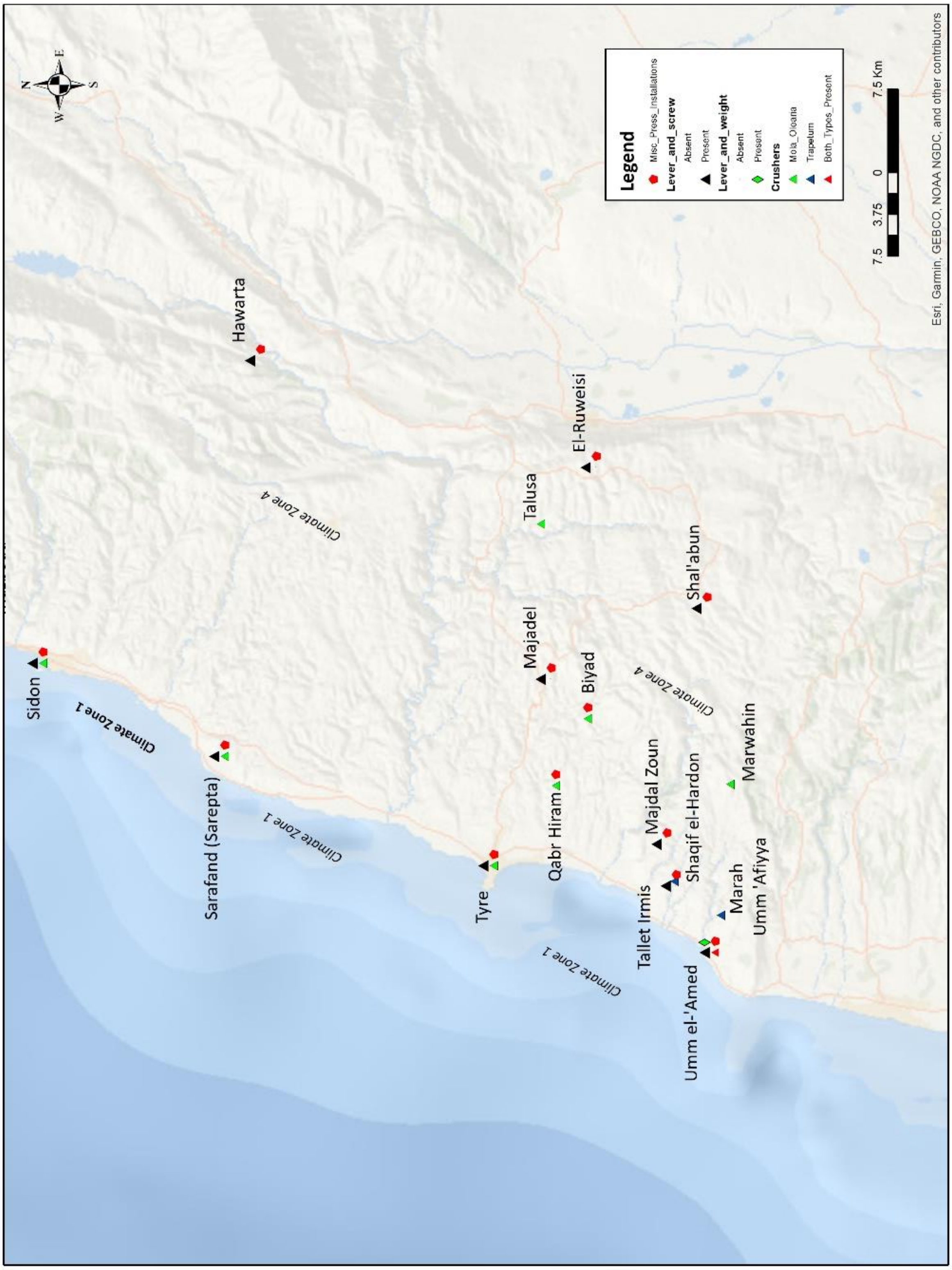

Figure 6.19: Distribution of pressing installations in southern Lebanon

South of Jiyeh, there appear to be five main concentrations of olive and wine presses, specifically at Sidon, Sarepta, Tyre, Umm el-‘Amed and the highlands between Tyre and Umm el-‘Amed. Sidon and Sarepta’s presses can be roughly dated to the Roman-Byzantine period, Tyre’s presses appear to be from the Byzantine period, Umm el-'Amed's presses were developed in the Hellenistic period, and the presses from the hinterland of southern Lebanon have not been specifically dated, apart from Biyad to the Roman-Byzantine period (Waliszewski 2014: 352-5). Crushing basins have been found throughout these regions, as well as lever-and-screw presses, attested primarily through the presence of screw weights (Waliszewski 2014: 350-1). Lever-and-weight presses are only attested at Umm el-'Amed, which would be expected as the site was initially founded before the development of the lever-and-screw press.

The numerous installations observed in the highlands east of Tyre corroborate the capacity of the Roman city in terms of its oil and wine production (Gatier et al. 2011). A similar pattern is probably also attested near Sarafand and Sidon, but there is a severe lack of publications in these regions. Indeed, the entire southern coast of Lebanon is characterised by frequent rock-cut press sites, particularly near Kharayeb just north of Tyre (McPhillips, personal communication). Future research might shed light on wine and oil production in southern Lebanon, but this analysis is outside the scope of this small section.

6.3.3 **Discussion**

Based on the data presented in this section, the majority of pressing sites appear to be situated in EZ 4 areas (well-precipitated highlands), followed by EZ 1 areas (coastal region), and finally by EZ 5 areas (fertile plain). This confirms the propositions made in Chapter 3 regarding the possible specialisation of the Mount Lebanon Range in viticulture and oleiculture. More specifically, though EZ 5 areas might be characterised by the most fertile soils, a temperate climate and a well-watered plateau, settlements in those regions seem to have focused on different forms of agriculture, while sites in the Mount Lebanon Range prioritised the growing of grapes and olives. This is surely related to the fact that the uneven topography in the Mount Lebanon Range does not allow for wide, flat farms to grow cereals, grains or other legumes in large quantities. Rather, through terracing, the well-filtered soils provide a conducive environment for various orchards, a majority of which seem to have been vineyards and olive groves. Some areas of particular specialisation in wine production did exist in the Bekaa (EZ 5 zone) at Baalbek and possibly around Deir el Ahmar, but most presses have been identified in the mountainous regions. Even at Baalbek, most identifications came from the base of the Anti-Lebanon slopes rather than within the city centre on the plains of the Bekaa.

Zone	Sites	Proportion
EZ 1	9	24%
EZ 4	21	57%
EZ 5	5	14%
EZ 4/5	2	5%

Table 6.5: The organisation of sites with evidence of pressing installations based on the environmental zones outlined in Chapter 3

Zone	Sites	Proportion
EZ 1	10	43%
EZ 4	12	52%
EZ 1/4	1	4%

Table 6.6: The organisation of sites with evidence of crushing installations based on the environmental zones outlined in Chapter 3

This differentiation can be further refined through an assessment of the distribution of crushing installations, which show a more even distribution between EZ 1 and EZ 4 areas (Table 6.6). Recalling that crushers are only utilised in olive oil production, the data does seem to indicate that specifically oleiculture might have been more prevalent at coastal sites and sites in the Mount Lebanon Range than in EZ 5 areas in the Bekaa. Specifically, 19% of pressing installations were identified from EZ 5 and EZ 4/5 (hybrid sites with precipitation and temperature levels similar to EZ 5 zones, but at a higher elevation and characterised by less fertile soils), but no crushers were found in similar contexts. Furthermore, only 24% of pressing installations were found in EZ 1 areas, but 43% of crushers were found in similar contexts. This supports the proposition that installations observed in the Bekaa might be more often associated with viticulture (Fischer-Genz 2016).

At Beirut specifically, the BCD excavations focused primarily on the urban centre, where there does not seem to have been any intensive agricultural production. While it is tempting to assume a clear differentiation between urban and rural areas, the former serving a consumptive and distributive role and the latter being characterised by agricultural production, this should not be taken as definite. The environs of Beirut, as seen in historical imagery from the early 19th and 20th centuries, were once covered with orchards and cultivated land. Though modern construction currently prevents detailed examination of the entire city, *vertic cambisols* cover the western extension of Beirut, and provide fertile land highly suitable for fruit trees. Thus, despite the lack of presses in the urban centre, it is quite likely the surrounding region was once a significant source of agricultural productivity (Figure 6.20). This is also supported by the sporadic data uncovered from the outskirts of the city that possibly reflect residential structures of a wealthier population (6.2).

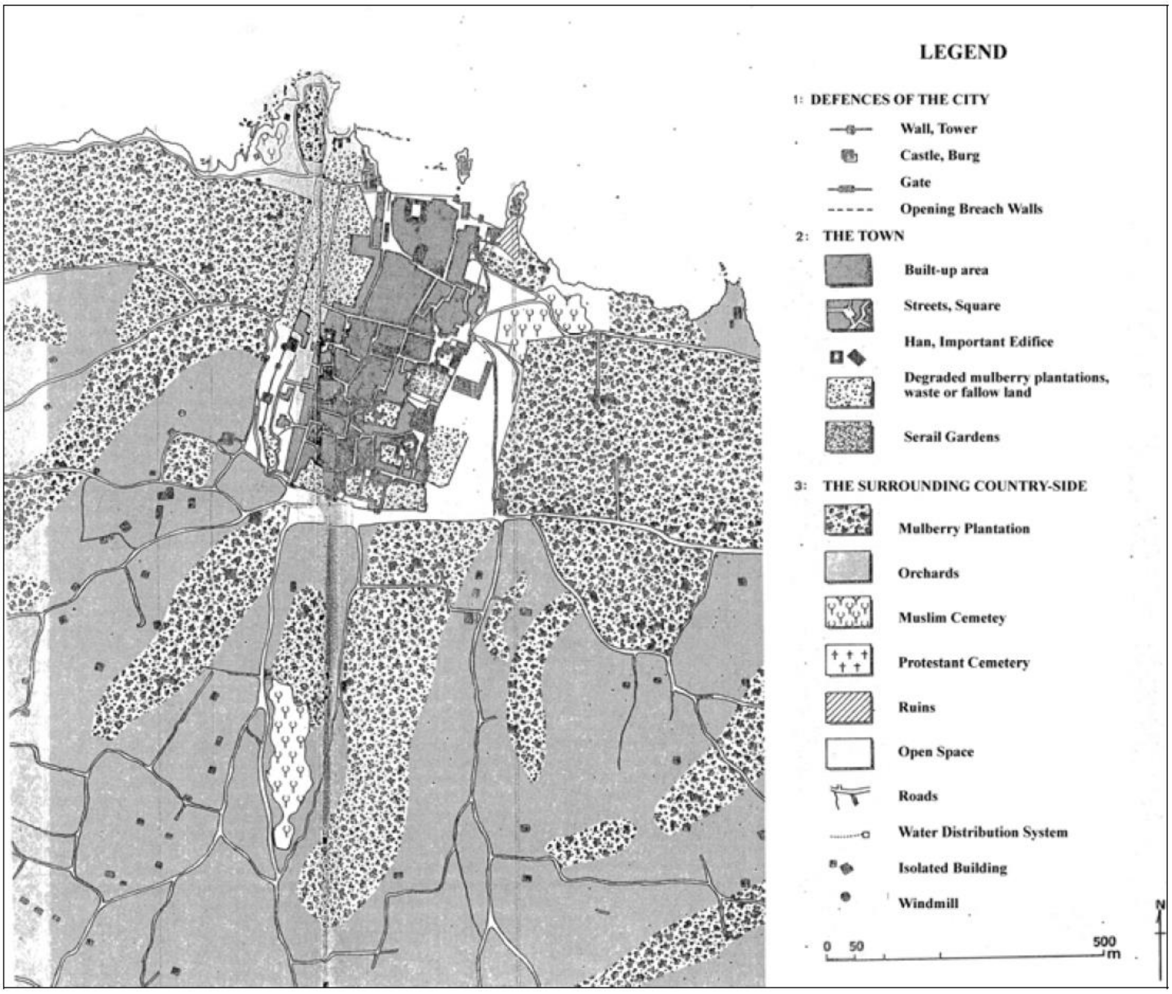

Figure 6.20: Beirut in 1841, depicting the density of mulberry plantations around the urban centre (after Davie 1987)

By comparing the distribution of rural sites to that of pressing and crushing installations, it seems that the sites of *Borama*, Mansourieh, Aintoura, Majdel Tarchich, Sannine and Hosn Niha/Niha in the hinterland of *Berytus* might not have been producing wine or oil. However, it must be stated that this can likely be attributed to the lack of publication rather than a true absence of pressing installations. Numerous sites throughout central Lebanon in the Mount Lebanon Range and in the Bekaa indeed are notorious for having been looted or destroyed in the past, sometimes resulting in the reutilisation of ancient masonry (even sarcophagi) in the construction of modern walls or structures (Salloum 2016: 288, Fig. 15; personal observation). Furthermore, given the high concentration of sites throughout Lebanon in EZ 4 zones, it seems likely that a similar pattern might be prevalent in the territory of *Berytus*, especially around the least-cost route south of Nahr Beirut. Regardless, at this time, Baalbek and Deir el Kalaa stand out as the production centres of wine and oil in the hinterland of *Berytus*, along with Deir el Ahmar, El Qafsiyeh and Al Jawzah.

6.4 The Beirut Amphora

Having discussed the production of wine and oil, I now turn to the manufacture of the primary containers that were used to package these agricultural products. In Beirut itself, three main amphora types were produced in kilns located within the city: the 'carrot' amphora, the AM 72 (types 1-3), and the Beirut Type. The carrot amphora is still not well understood, and there are a number of different variations and wares associated with the type, with sources often specified all over the Levantine coast (Gendelman 2012: 35; Kaldeli 2013b; Reynolds 2005). Furthermore, it is still unclear whether carrot types identified throughout the Mediterranean are, in fact, of the same type, or of a similar tradition but produced in different locations (Waliszewski et al. 2002: 75). At this point, the only viable proposition is that at least some of the carrot-type amphorae were produced in Beirut, but not necessarily all of them. The amphora is believed to have been used to package fruit (possibly dried dates or plums) or fish sauce (Reynolds 2005: 567, 605; 2008: 76). The AM 72 type, also produced at Byblos, Yannouh and possibly Tripoli, is commonly found throughout Beirut, and is believed to have been produced at two workshops in Beirut itself (Wicenciak 2016a: 661). The type was possibly used to package fish sauce or wine based on typological comparisons to Beltrán IIB or Dressel 7/11 amphorae, but also resembles the Koan-style amphora, which might be indicative of wine (Reynolds et al 2010: 79).

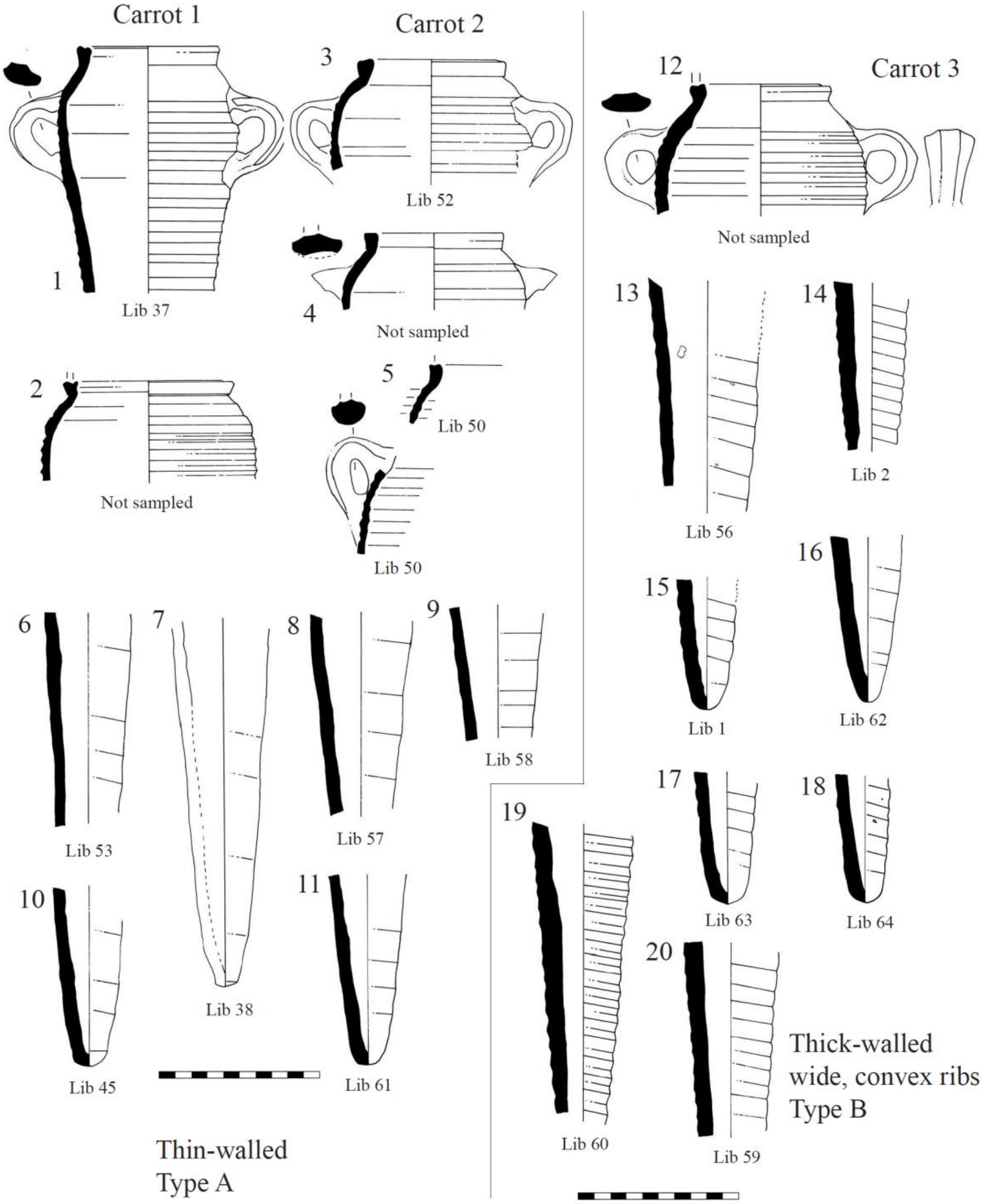

Figure 6.21: Typology of the 'carrot-type' amphora produced in Beirut and possibly at other locations (after Reynolds et al. 2010: 103, Fig. 7)

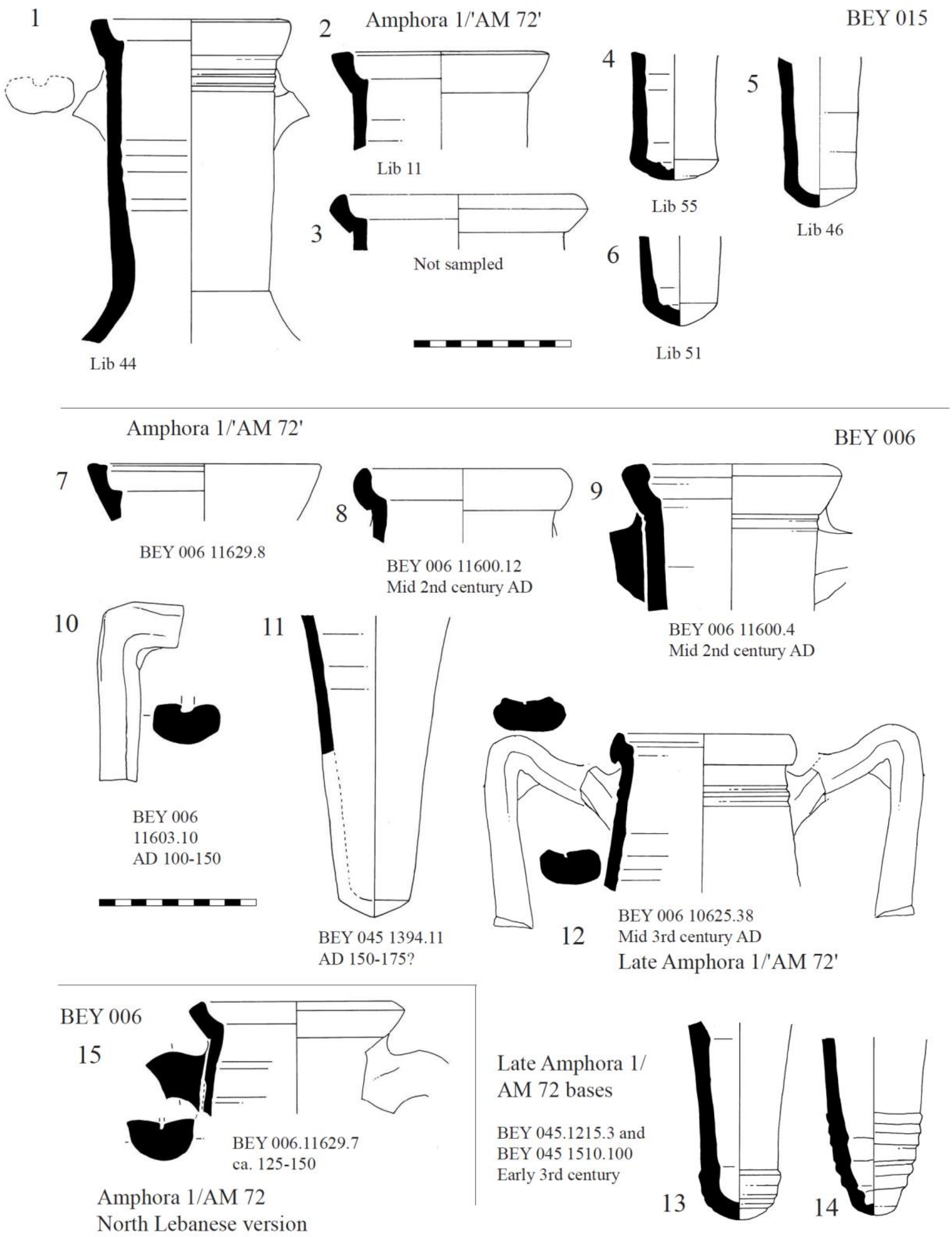

Figure 6.22: Typology of the AM 72 amphora; 1-14 are products of Beirut, and 15 is possibly a product of northern Lebanon (after Reynolds et al. 2010: 109, Fig. 13)

However, the vast majority uncovered at Beirut and identified at workshops are of the Beirut Type, a type that has been sourced to workshops in Beirut and at some regional sites in Lebanon. Since the Beirut Type represents roughly 60-65% of amphorae sherds uncovered in the BCD excavations (sample taken from BEY 006, 007 and 045; Reynolds 1999; 2000a), it seems to have been the primary container used to package various agricultural products in the city, probably mostly wine (Woodworth 2011). For these reasons, the ceramic analysis in this thesis focuses primarily on the Beirut Type in an attempt to shed light on the production and distribution of wine and, to a lesser degree, olive oil sourced to sites within the territory of *Berytus*. Previous studies have outlined the type in detail and proposed preliminary patterns of distribution and economic organisation (Reynolds 1999; 2000b; 2005; 2008; Wicenciak 2016). In this section, the author briefly summarises these examinations and discusses the manufacture of the Beirut Type in Beirut and the surrounding region.

6.4.1 **Typology**

The earliest form of the Beirut Type has been dated to the 1st century BC (Reynolds 2000b: 387), though production may have started in the 2nd century BC (Ala Eddine 2005). The form – Beirut Type 1 – has a projecting rim and fairly large handles. This differs from the Phoenician and Persian-Hellenistic forms which are rounded, almost egg-shaped jars with little to no neck and handles near the mouth of the vessel (Reynolds 2000b: 387). The more pointed base differentiates this type from the Hellenistic ‘Sidonian’ form observed frequently in the south of Lebanon.

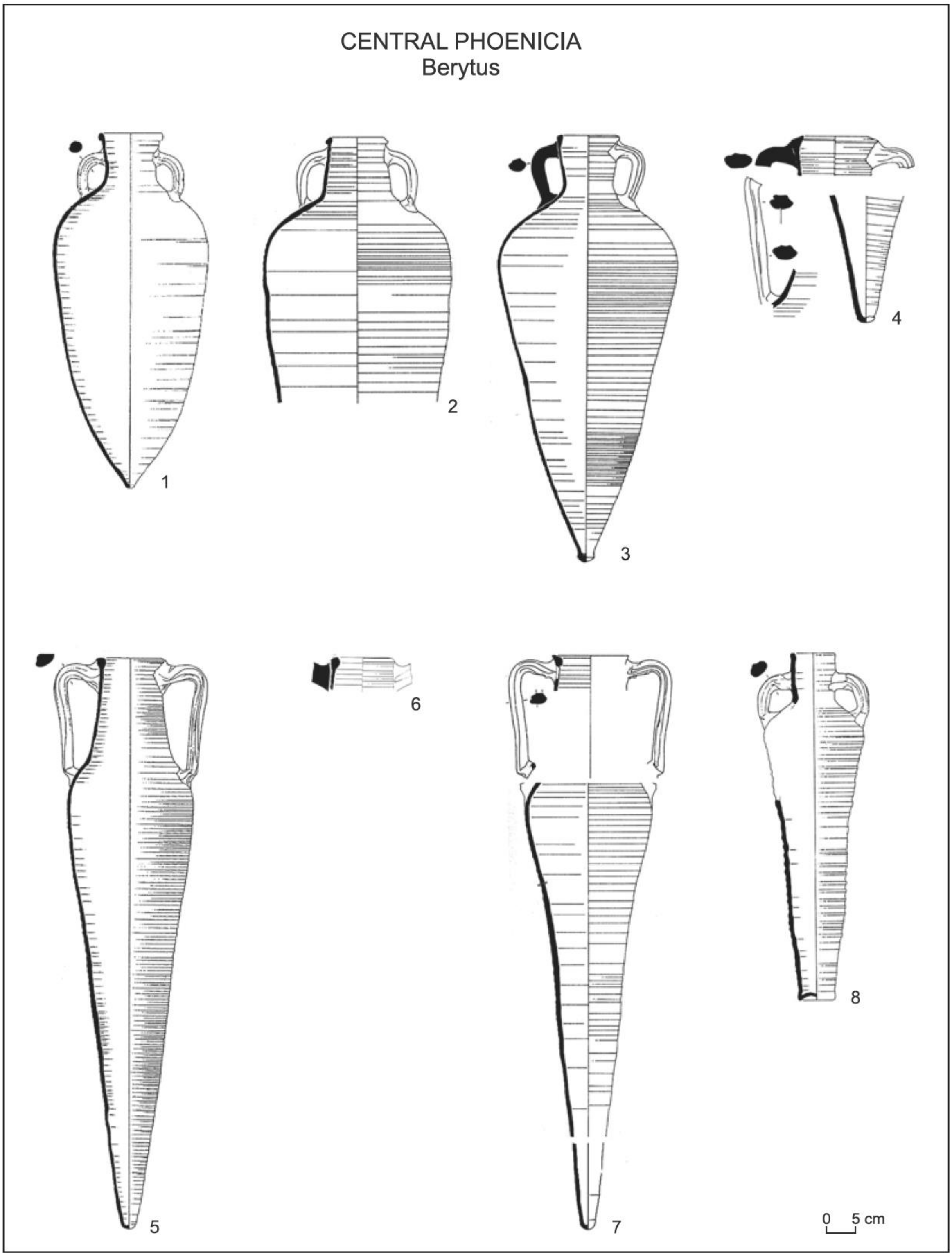

Figure 6.23: Overall typology of the Beirut Type (after Wicenciak 2016a: 654, Fig. 11)

Beirut Type	**Date of Production**	**Production Sites**
1	late 2nd BC to early 1st AD	Beirut
2	first half of 1st AD to beginning of 2nd AD	Beirut, Jiyeh, Khalde

3	end of 1st AD to mid-2nd AD	Beirut
4	end of 2nd AD to mid-3rd AD	Beirut
5	second half of 4th AD	Beirut
6	mid-4th AD to 5th AD	Beirut
7	mid-5th AD to mid-6th AD	Beirut, Khalde
8	second half of 5th AD to mid-7th AD	Beirut, Bekaa Valley?

Table 6.7: Outline of Beirut Type according to Reynolds's typology (2000b) and Wicenciak's recent discussion (2016a)

Beirut Type 2 is significantly different from earlier forms. The vessel is thin-walled, with a short cylindrical neck, a folded-band triangular rim, tapered body and knob base (Reynolds 1999: 59; Wicenciak 2016a: 655). The maximum height of this type was probably around 70cm, and it had 'Beirut-type handles', which were oval in section, with centrally located flat bands with two grooves to both sides (Reynolds et al. 2010: 75; Wicenciak 2016a: 655). These types were made to transport wine and were sometimes stamped 'COL BER' (*Colonia Berytus*) to specify them as products of the Roman colony (Perring et al. 2003: 208). This feature of the amphora is quite crucial in its interpretation, as the stamping of an amphora with the name of a colony is not common (9.2). The Beirut Type 2 amphora was produced in both Jiyeh and Khalde, though stamped examples have not been found at either site (Waliszewski et al. 2006: 59; Wicenciak 2016a: 656).

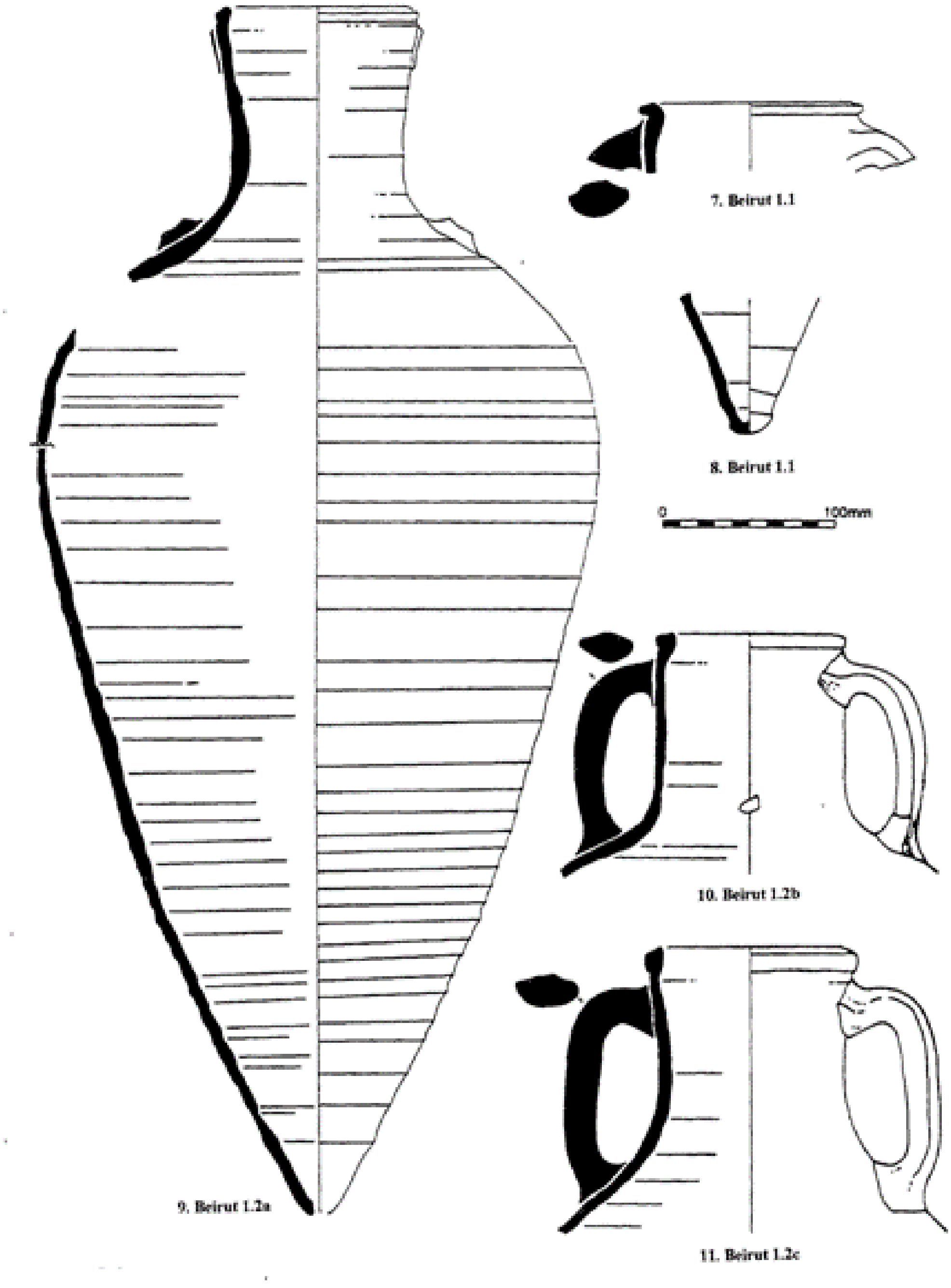

Figure 6.24: The Beirut Type 1 amphora, initially produced in the late 1st century BC into the 1st century AD (after Reynolds 2000b: 389, Fig. 2)

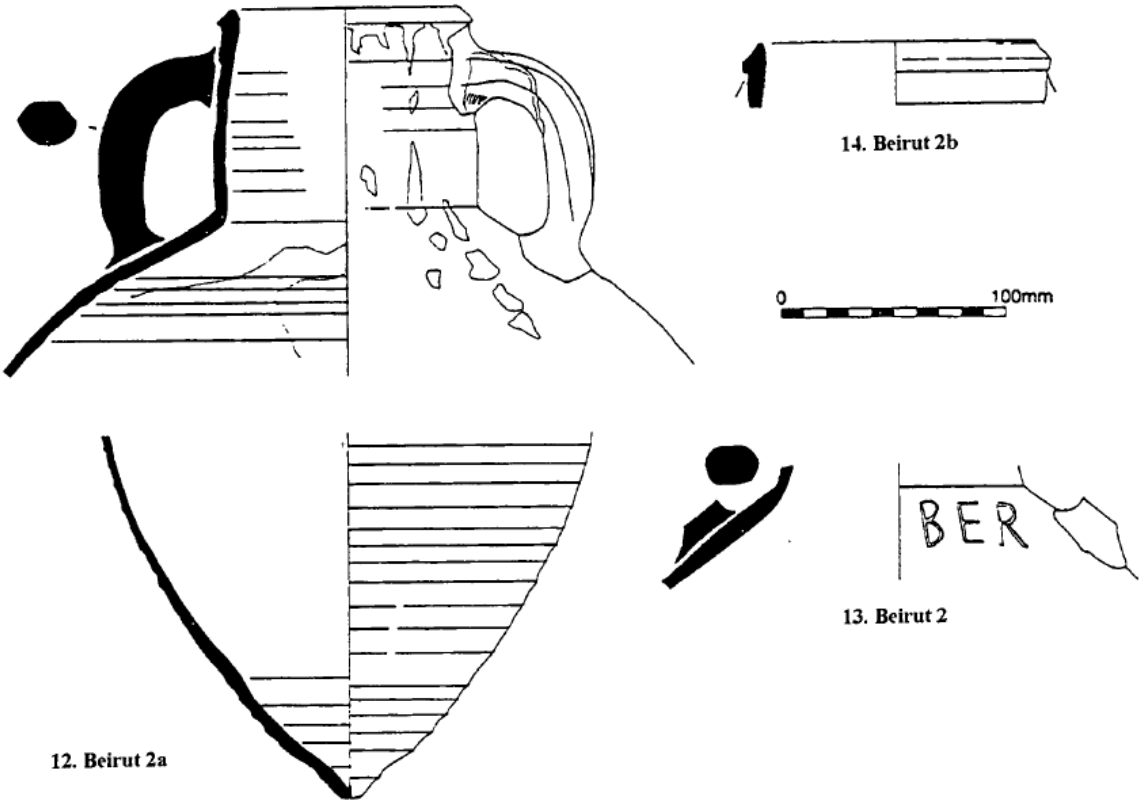

Figure 6.25: The Beirut Type 2 amphora, produced between the first half of the 1st century AD and the beginning of the 2nd century AD (after Reynolds 2000b: 390, Fig. 3)

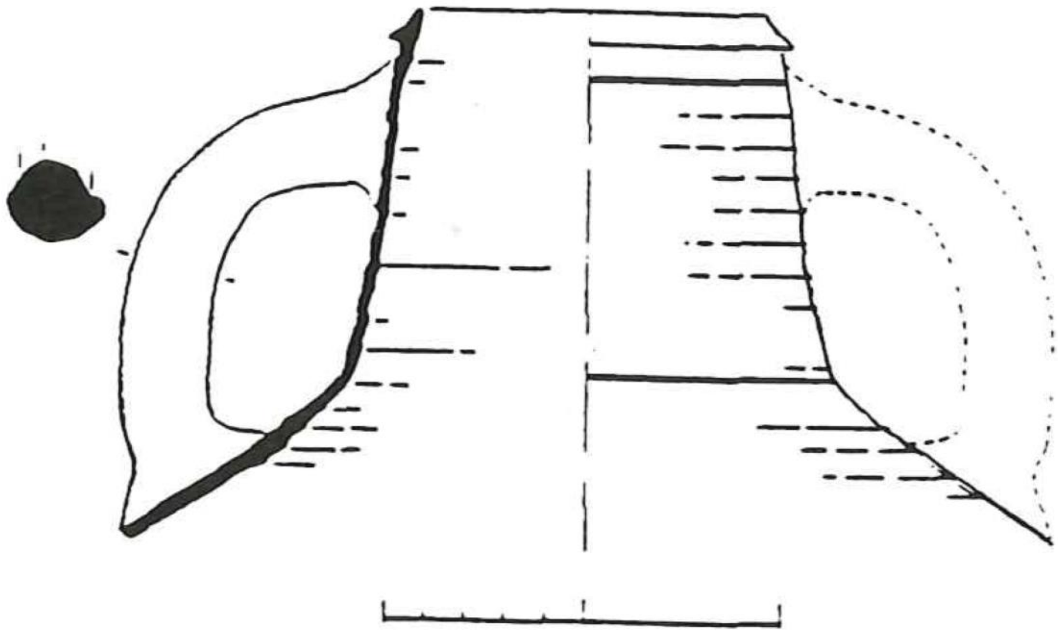

Figure 6.26: The upper body of a Beirut Type 2 amphora found in Athens (after Hayes 2000: 290, Fig. 13)

Figure 6.27: Several examples of the Beirut Type 2 amphora produced in Jiyeh; top two examples come from wasters (after Wicenciak 2016b: 302, PL. XCIV)

Beirut Type 3 was produced locally at the kiln sites in BEY 015 from the end of the 1st century AD to the mid-2nd century AD (Wicenciak 2016a: 657). The form has a carrot-shaped body with a knob base, bearing close resemblance to the Beirut 1C amphora, while the rim and the shape of the small handles resemble the Beirut 2 Type (Reynolds 1999: 59; 2000: Figs 4, 5.16-18). One of the main differentiating factors is a thickened, triangular rim, which is consistent across all sub-sets of this type (types 3.1, 3.2, and 3.3) (Wicenciak 2016a: 657).

Figure 6.28: A complete example of the Beirut Type 3 amphora found in Sussex, England; the longer, inward-turning handles and more carrot-shaped body differentiate this type from the previous Beirut Type 2 amphora (after Hayes 1976: 66, Pl. 39.360)

Beirut Type 4, produced from the end of the 2nd till the mid-3rd century AD, is distinctly larger in size than the older types (Reynolds 2000: 388; Wicenciak 2016a: 657). Compared to earlier variants, the rim of Beirut Type 4 is more curved and everted outwards, with a conical base and straighter walls. The body is more carrot-shaped, bearing some resemblance to Beirut Type 1 and 3, and high arched handles that descend towards the body and attach to the shoulder. They are significantly wider and longer than previous types, and the volume of the Type 4 amphora is nearly twice that of Type 2. It is claimed that Type 4 is fairly common throughout the Mediterranean (Ala Eddine 2005: 193; Reynolds 2000: 388, 391).

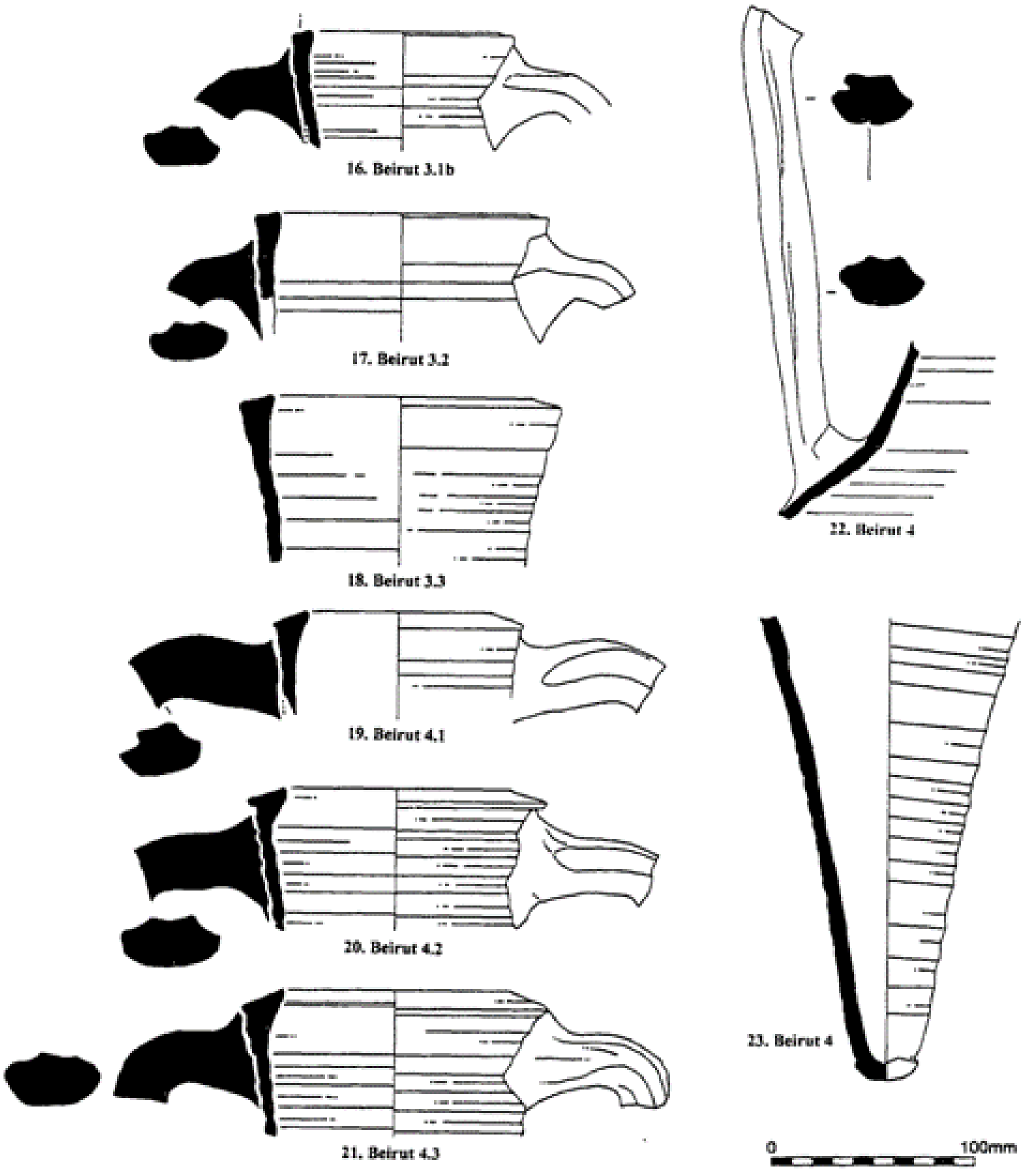

Figure 6.29: Beirut Types 3 and 4, 2nd to early 3rd centuries AD (after Reynolds 2000b: 392, Fig. 5)

The Beirut Type 5 amphora was produced starting in the second half of the 4th century AD, and is markedly different from the early forms. The amphora has a thinner rim and rounder, external, protruding lip (Reynolds 1999: 61, Figs. 237-45; Wicenciak 2016a: 657). The handles are also quite massive, similar to Type 4, and attach to the amphora closer to the edge of the shoulder compared to early forms, descending nearly evenly at the same angle with the body (Figure 6.23). The body is much more carrot-shaped, and the shoulders are less pronounced. Especially regarding the handles, rim, lip and neck, the type bears some resemblance with the Agora M334 type, and it is possible that the Beirut Type 5 amphora was inspired by this form (Wicenciak 2016a: 658).

The Beirut Type 6 amphora is still not well understood, and there are some ambiguities regarding its place of production. It was produced from the mid-4th to the 5th century AD, and has been distinguished into two main types: 6.1 and 6.2. Type 6.1 has a bulbiform rim with a groove and ribbing on the neck, while 6.2 does not have a groove on the rim (Reynolds 1999: 61-2). 6.1 was made of a sandy fabric with a buff colour, distinctly different from the Beirut fabric, and found commonly in deposits dated to the 5th century AD. Type 6.2 was made from the Beirut fabric and was found generally in contexts dated to the second half of the 4th century AD (Wicenciak 2016a: 658).

The Beirut Type 7 amphora was produced from the mid-5th to the mid-6th century AD, and its shape is very similar to that of the Beirut Type 5 amphora, with the only difference being a rounded rim truncated on its inner side, and the handles of the Type 7 form diverging even further outwards than those of the Beirut Type 5 amphora. The upper part of the body near where the handles attach is more bulbous, resulting in a more pronounced carrot body. The type seems to have also been produced in Khalde, though the material from excavations has not yet been published (Reynolds 2005; Wicenciak 2016: 258).

The Beirut Type 8 amphora is significantly morphologically different from previous forms, with two main subtypes: 8.1 and 8.2. Type 8.1 is present in contexts from the second half of the 5th century AD, while 8.2 comes from layers dated to the mid-7th century AD. Type 8.1 has a ribbed neck ending in a wide band rim, sometimes unevenly finished. The handles are attached quite low down on the neck, and are much smaller than previous variants. Type 8.2 has ring-type handles attached even lower on the neck. It has a rim that is essentially just an extension of a ribbed, taller, narrower neck, and a smaller base than 8.1 (Reynolds 1999: 62). The primary differentiating factors are the ring handles and the flat, almost cylindrical base, compared to all previous Beirut Type amphorae having a pointed or button base. This form was made in two fabric types: the Beirut City Fabric and the CW 34 fabric on a kaolin clay base, possibly produced in the Bekaa

Valley, but also possibly in the Mount Lebanon Range, as attested at Al Jawzah (Nacouzi et al. 2004; Wicenciak 2016a: 675).

All Beirut Type amphorae sourced to Beirut were produced in the Beirut City Fabric, described by Reynolds and compared to the Jiyeh and Khalde fabrics,

> 'Orange/red brown in colour, often with pimply surfaces due to the common mix in size of fine to 1mm semi-rounded quartz grains. The lime content varies from moderate to common, and varies from fine up to 0.5mm in size when viewed in a granular break. Vessels from Jiyé (near Sidon) are identical to the Beirut fabric, fired red brown or reduced dark grey in colour with pimply surfaces, quite compact. Perhaps less lime and less sandy than Beirut city products? There are also some pale yellow examples (cf. similar fabric for some AM 72 amphorae). The Khalde examples have a more pale rusty orange fabric with common fine lime. The surface colour tends to rub off.'
>
> **(Keay and Williams 2014)**

It is formed of calcareous clay, and seems to be very similar visually to the Jiyeh Fabric (orange-red to brown-red in colour, 10 R 5/8, 5 YR 7/6, 2.5 YR 4/8, or 10 R 4/8). Vessels are typically dense and well fired, with limestone grain inclusions (usually around 0.5 mm) (Reynolds et al. 2010: 84).

In terms of the packaged product, wine seems to be a likely candidate based on preliminary chemical analysis (Woodworth 2011). This does not necessarily exclude the possibility of other agricultural products also being packaged in the vessel, but it confirms that at least some of the Beirut Type amphorae were used to transport wine. Reynolds has also proposed that the dark stains observed on the inner sides of the rims and necks of Type 2 are further indications of wine being the primary product (at least for this variation) (Reynolds 2000b: 387).

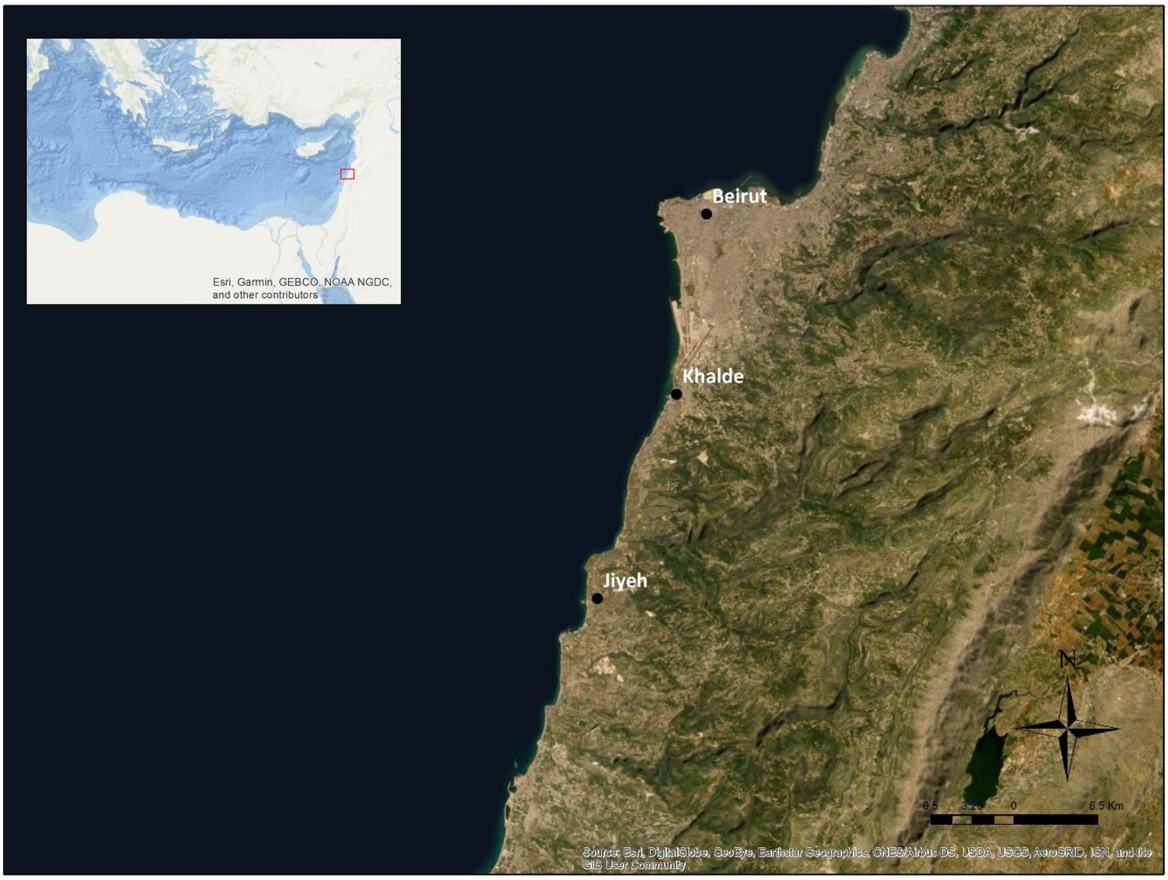

Figure 6.30: Known production centres of the Beirut Type

6.4.2 Workshops and kilns

6.4.2.1 BEY 015 and JEM 002

Within the urban centre of *Berytus* itself, the primary workshop was uncovered at BEY 015 in the eastern quarter of the city. This area appears to have been an artisanal sector, where different workshops were uncovered that produced glass vessels and various ceramics, including kitchenware and amphorae (5.3), as well as metallurgical workshops (Kowatli et al. 2008). Each workshop functioned at different times, with gradual transitions being evident in the archaeological data. Specifically, tanks used for the production of raw glass, dated to the mid-1st century AD, were eventually substituted by four kilns for firing vessels. Ceramic sherds and production waters were found in context with the kilns (Kowatli et al. 2008; Reynolds et al. 2010; Wicenciak 2016a: 652). The material uncovered from this sector is largely unstratified, and, as a result, specifying time frames of activity is quite difficult. An active phase has been proposed roughly between 80 AD and 125 AD based on the amphorae and cooking pots, as well as PIXE analysis of the Beirut amphorae uncovered in the context (Roumié et al. 2004). However, the initial date seems to be slightly earlier based on the identification of several fragments of production wasters dated to 50 AD (Wicenciak 2016a: 652).

There is a definite discrepancy between the centre of the city, characterised by grandiose buildings, large domestic dwellings, temples, baths and the main streets of the city, and kilns and workshops of BEY 015 in the eastern quarter of the city. Storage facilities also were identified adjacent to the workshops and kilns, further corroborating the characterisation of this region as a functional region of the city, where ceramic products and glass ware might have been stored (Curvers and Stuart 2007). The kiln of BEY 015 is located adjacent to the proposed coastline in the Roman period. It also lies in line with the extension of an E-W street leading from the northern part of the city centre to the workshops (see Chapter 5). Assuming the wine or oil was packaged at the workshops themselves (Broekaert 2012), this allowed easy access to and from the harbour and facilitated the loading of packaged agricultural products on merchant vessels directly from the packaging site.

Roughly 100m south of BEY 015, the site of JEM 002 has also revealed evidence of pottery kilns, with pottery dated to the mid-1st century AD (Reynolds et al. 2010: 71). This would indicate that the workshop functioned just before that of BEY 015 (in terms of amphora production). It encompasses a necropolis dated to the Hellenistic period, located outside the Hellenistic city limits (Reynolds et al. 2010). However, material from the site has not been published, and propositions regarding the production centre are still preliminary.

As the only vessels that have been uncovered in BEY 015 date to the 1st and 2nd centuries AD (Beirut Types 2-3) and those in JEM 002 date to the 1st century AD (Beirut Type 2), the assumption that all Beirut Type amphorae were produced in Beirut is based solely on analysis of the fabric. Beirut Types 4-8 are found abundantly all over the city, and were produced in the Beirut City Fabric, but have not been found in context with the workshops. Publications sometimes refer to BEY 015 and JEM 002 as production centres of all variants of Beirut Type amphorae (Wicenciak 2016a: 653), but archaeologically, this has not been shown. Given that the wares of Beirut Types 1-7 sourced to Beirut are identical and identified as the Beirut City Fabric, it seems more reasonable to state that most Beirut Type amphorae were produced in Beirut, probably in the eastern quarter of the city (where workshops are largely situated), but not necessarily within the workshops identified at BEY 015.

6.4.2.2 Khalde (*Heldua*)

At the site of Khalde, roughly 12 km south of Beirut, production wasters of the Beirut Types 2 and 7 amphorae were uncovered from excavations. This information has been gathered from unpublished material, thus, detailed analysis of the workshops is not possible at present. It appears that kitchen vessels were also produced in Khalde around the 5th century AD in the Heldua Fabric (Reynolds 2005: 569; Reynolds et al. 2010: 73). The fabric of Khalde has been described as light orange in colour, and tempered with fine limestone inclusions. One of the main characteristics is the orange trace it leaves on one's hand (Wicenciak 2016a: 651). Reynolds and Waksman describe the fabric as follows:

> 'A bright orange fabric. Gritty, but with a slight soapy texture. Leaves traces of orange colour on your hands. Quartz and lime inclusions. Some oxide? Not distinctive in this respect but does stand out from standard Beirut products which have more quartz. The orangy quartz rich fabric recalls the products of Sidon (just to the south) but is distinguishable from Khalde Ware because Sidonian products have more (rounded) quartz.'
>
> **(Reynolds and Waksman 2012)**

Most importantly, the fabric is clearly distinguishable from both the Beirut City Fabric and the Jiyeh Fabric. None of the vessels identified at Beirut have been sourced to Khalde.

6.4.2.3 Jiyeh Sector B4

Another major production site was identified at Jiyeh. Although a magnetic mapping of the site suggests the presence of potential pottery kilns, excavations did not uncover physical remains to corroborate the magnetic anomalies (Wicenciak 2016b: 25). Remains of ash and pottery production wasters, dated roughly to the late Hellenistic and early Roman periods were observed in this region, leading to the proposition that the site was, in some way, characterised by ceramic production. A number of vessels appear to be very similar to ceramics produced in Beirut, particularly in the presence of the Beirut Type handle (Wicenciak 2016b).

In Sector B, specifically in the test trenches of B 1-3 and 5, ceramic evidence indicates a production phase in the late Hellenistic period (Wicenciak 2016b: 41). In B4, the excavation of a deep well revealed a deposit over 2m thick of Beirut Type 2 amphorae, constituting roughly 40% of the pottery uncovered in the well (Wicenciak 2016b: 77). In later periods, Jiyeh produced the carrot-bodied AM 14 amphorae, known to have been produced in the Akko/Ptolemais region, as well as a small version of the Agora M334 amphora (Wicenciak 2016a: 649-50).

Wicenciak provides detailed descriptions of wares of various phases of production at Jiyeh, differentiating a Late Hellenistic ware, Early Roman ware, Late Roman ware and Byzantine ware. The Early Roman ware corresponds to that used to produce Beirut Type 2 amphorae, a red clay (2.5 YR 4/8 or 10 R 4/8) with a narrow black or grey core. It has a smooth surface, and is almost identical to the Beirut City Fabric (Wicenciak 2016b: 76). Unfortunately, this makes the differentiation between Beirut products and Jiyeh products quite difficult. No maritime installations have been identified at Jiyeh (Waliszewski et al. 2006: 21-23), though, as discussed earlier, the area is relatively well-sheltered with a sandy beach. Thus, considering the density of pressing installations found in its hinterland, Jiyeh might have been capable of producing, packaging and shipping its own version of the Beirut Type without necessarily going through Beirut. However, pending further research, the similarity between each ware makes such a differentiation troublesome.

Jiyeh represents an interesting example because it initially produced the Sidon 2 amphora in the Hellenistic period (a form also produced in Beirut) before switching to various other forms, including the Beirut Type 2 amphora. It has been suggested that this change in manufacture reflects a dynamic political situation, where Jiyeh was initially a part of the territory of Sidon, and subsequently absorbed into the colony of *Berytus* in the Roman period (Reynolds 2008: 76-7). However, this is based solely on the shift in amphora production. Another possibility is the mimicking of a successful market, or simply the adoption of the new regional tradition without political implications (Peña 2007: 43). The arrival of the morphologically different Beirut Type 2 amphora may have been circumstantial, attributable to the emergence of workshops that tailored production to the requests of the changing social landscape. This is also supported by the fact that the peripheral workshops at Jiyeh and Khalde only produced the Beirut Type 2 amphora in the Imperial period (coinciding with significant social changes), and subsequently produced a range of vessels after this phase ended. Given the density of pressing installations in the hinterland of Jiyeh, suggesting some degree of a self-contained system, this would make sense.

6.4.3 **Discussion**

The establishment of the Beirut Type in the late-2nd century BC indicates that the early forms do, in fact, predate Roman colonisation. Production of this specific amphora began roughly in the ‘independent’ period, when Beirut was liberated from Seleucid rule. Significant morphological developments are witnessed between the 1st century BC and 1st century AD as attested in the Beirut Type 2 amphora, corresponding to Roman colonisation. The city itself witnessed significant private and public construction at this time. After the 1st century AD, building and refurbishment appears to have slowed (Perring et al. 2003: 212), possibly related to political changes in the region. This time period corresponds to the production of Beirut Types 3-4, which are larger in size compared to Type 2 and able to transport a larger volume of product. Beirut Types 5-7, dating roughly to the 4th century AD to the 6th century AD, were produced during a time of intensive private construction and refurbishment throughout the city centre. Large and expensively decorated town houses were introduced to areas that were previously quite modest (Perring et al. 2003: 213-4). Beirut Type 8 was produced in two subtypes, one in the late 5th century AD, corresponding to the 'flourishing' period before the devastating earthquake of 551 AD, and another in the mid-7th century AD, almost a century after the earthquake. Thus, the effects of the catastrophic climatic event may have affected the production and packaging of wine and oil at this time.

6.5 Conclusion

Viticulture and oleiculture seem to have been associated primarily with the highlands of the Mount Lebanon Range or along the western slopes of the Anti-Lebanon Mountains. The difference in pressing installation distributions between Baalbek and Kamid el Loz indicates that the wide plains were utilised for different kinds of agriculture. Thus, one explanation is that proposed by Fischer-Genz (2016: 62), namely that the region around Baalbek involved a niche economy based primarily on grapes, and subsequently processed into a refined agricultural product. This theory is quite attractive given the available survey data that shows a lack of pressing installations in the south-eastern portion of the Bekaa Valley near Kamid el-Loz. Furthermore, the development of other production centres of the Beirut Type primarily in the Imperial period might be indicative of concurrent intensive wine and oil production. In this way, perhaps the trends observed in Beirut Type workshops mirror specialised agriculture in the sampled sites. To shed light on these processes, the following chapters assess the extent of distributions of these products, which possibly reflects the level of surplus that was output at this time.

Chapter 7 **Distribution of the Beirut Amphora**

> *After the wines mentioned by Homer, and of which we have already spoken, those held in the highest esteem were the wines of Thasos and Chios, and of the latter more particularly the sort known as Arvisium… Next in esteem after these are the wines of Sicyon, Cyprus, Telmessus, Tripolis, Berytus, Tyre, and Sebennys*.
>
> - **Pliny *NH* 14.9.7**

One of the effective ways of shedding light on the patterns discussed in the previous chapter is by examining the subsequent distribution of the wine and oil of *Berytus* to the surrounding region. The scope and scale of distributions is indicative of whether agricultural activity in the hinterland of *Berytus* was intended for the self-sufficiency of rural sites, consumption on the local scale, or marketing in the wider region (De Sena 2005; Rice 2016: 192). Since these products were primarily packaged in the Beirut Type, this can effectively be done through the tracing of that type's distribution, complemented by a consideration of other regional types.

As attested by Pliny in the quote above, the wine of *Berytus* seems to have been held in some regard. But how did this translate commercially in the form of exports around the Empire? Some propositions have been made regarding the capacity of commerce involving wine and, to a lesser extent, olive oil (Butcher 2003: 197; Paturel 2019: 145; Reynolds 2000b; 2005), but there has not been any formal analysis of the distribution of the Beirut Type in a defined region. Therefore, in this portion of the thesis, I detail the quantitative data of the type's distribution at various port sites throughout the eastern Mediterranean, primarily on the Levantine coast and Cyprus (4.3.1), and briefly contextualise each port site geographically and historically. The chapter is organised according to Roman provincial divisions, beginning with the Phoenician coast (*Syria Coele/Syria Phoenice*; 7.1), followed by the regional provinces of the southern Levant and Egypt (*Judaea*/*Syria Palaestina* and *Aegyptus*; 7.2.1), coastal Syria (*Syria Coele*; 7.2.2), and Cyprus (section 7.2.3). This allows for a consideration of the local scale, defined here within the borders of modern-day Lebanon (which is quite comparable to those of *Syria Phoenice*; Millar 1993: 122), as well as the regional scale, characterised by the surrounding Roman provinces of the Levantine coast and Cyprus. On the local scale, a variety of sites, both terrestrial and maritime, have been included in examination, in an effort to get a preliminary idea of the type's permeation inland, and its density at Lebanese sites generally. On the wider scale, only port sites according to the criteria discussed in 4.3.1 were included in the study. Specifically, these criteria are: a quay or docking area; storage space related to the deposition and holding of various imported goods or those intended for export; administrational structure involved in buying, selling, packaging and processing goods for shipment or import; and an intertwined network with the regional hinterland.

7.1 The Beirut Type Amphora in Lebanon

7.1.1 Northern Lebanon

In northern Lebanon, distribution of the Beirut Type is quite limited. Imperial forms are completely absent at both coastal and inland sites, though the ports of Tripoli, Batroun, Byblos and their associated hinterlands are clearly under-published (Figure 7.1). Byzantine forms are present sporadically, in the form of several sherds of Beirut Type 8 at Anfeh (personal communication with Lucy Semaan) and two sherds at Ain Ikrine inland, representing 9.1% of the assemblage (Fares 2010: 106). The absence of the form at the sites of Deir el Ahmar and Baalbek, which are characterised primarily by local forms (Hamel 2014; Salloum 2016: 292), is quite important when considering the frequency of Baalbek amphorae observed in Beirut (Reynolds 2000b; 2005). This lack of reciprocity might be indicative of a one-directional provision of wine and oil-related material (amphorae and product) from Baalbek to Beirut.

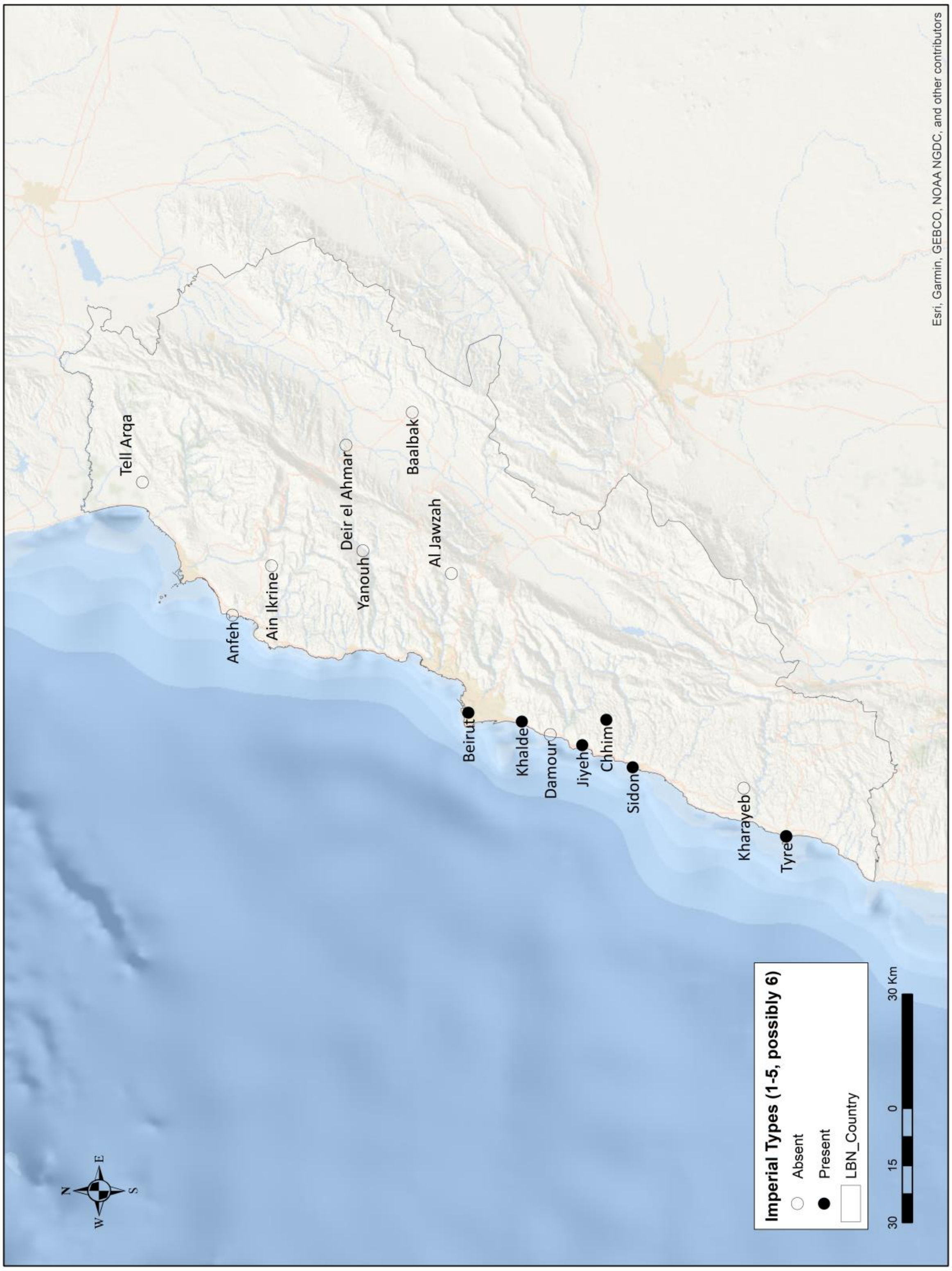

Figure 7.1: Distribution map of Imperial forms (Types 1-5, and possibly type 6) in Lebanon based on published ceramic reports and personal communication with excavators

The presence of Beirut Type 8 sherds at Al Jawzah in a ware distinctly different from the Beirut City Fabric and the Early Roman Jiyeh Ware indicates the possibility of another production centre, possibly in the Bekaa (Reynolds 2005; Wicenciak 2016a). Furthermore, its presence in the hinterland of *Berytus* suggests that packaging might have been undertaken at sites outside the city centre, though the subsequent distribution of amphorae produced in this distinct production centre is unclear. More specifically, given that Al Jawzah was also a production site of wine and/or oil, it is possible that these sherds are related to the packaging of either product. Conversely, we cannot eliminate the possibility that their presence is related to local consumption.

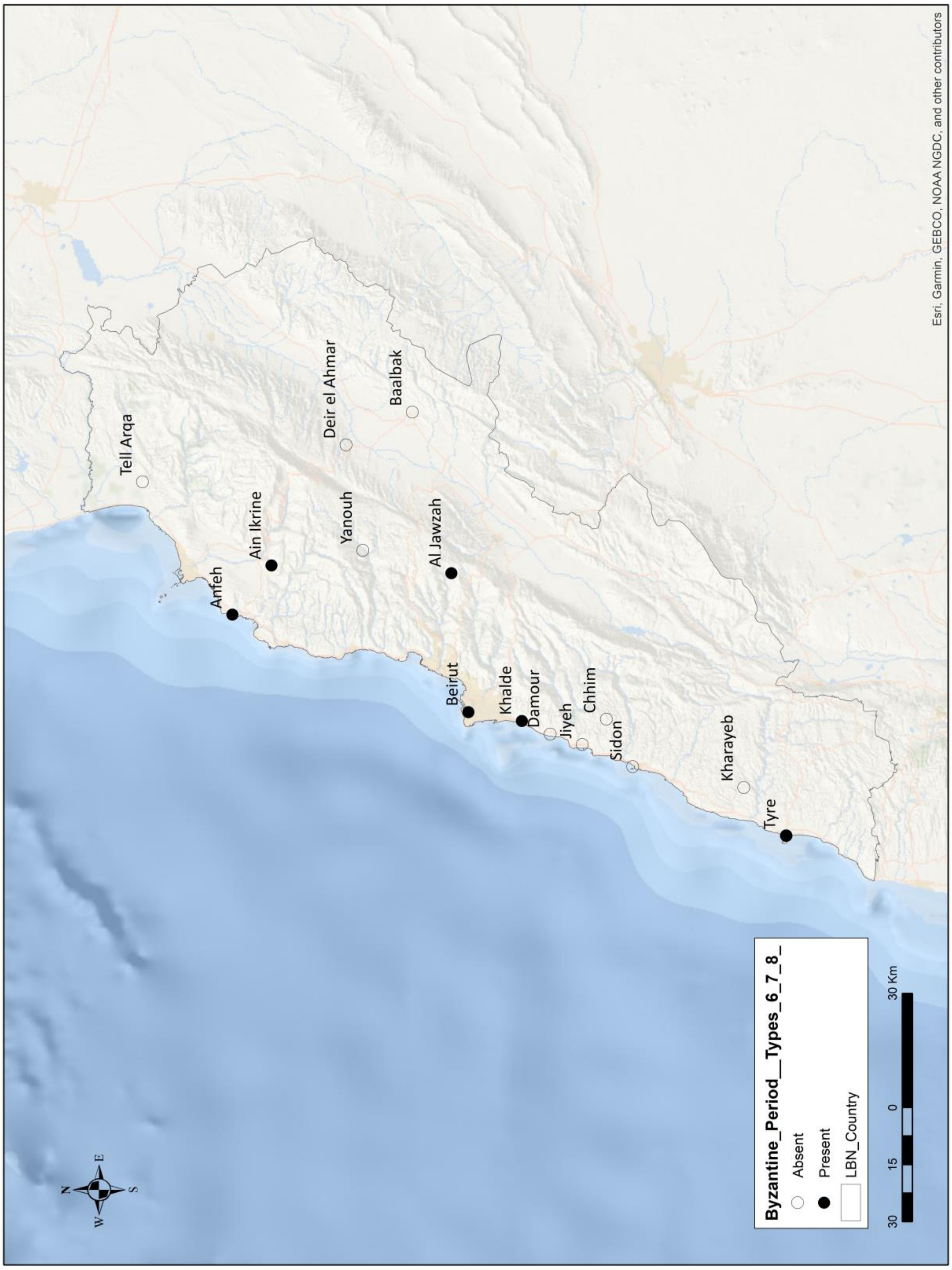

Figure 7.2: Distribution of Byzantine forms (Types 6/7-8) in Lebanon

7.1.2 Southern Lebanon

In the south, Imperial forms (Beirut Types 2 and 3) are encountered at several sites, and later forms are mostly absent (apart from Beirut Type 7, which was produced in Khalde, and an unspecified Byzantine form in Tyre). This includes the production centres of Jiyeh and Khalde, where Beirut Type 2 was produced. Beirut Type 3 is also observed in Jiyeh in the residential sector, indicative of consumption rather than production, though the frequency is not known (Wicenciak 2016a: 657). At Sidon, 8 sherds representing 8 MNI of Beirut 2 or Jiyeh 6 amphorae were uncovered in a well from recent excavations (Wicenciak 2016a: 111-2). Preliminary examinations by Wicenciak indicate that the ware more closely resembles that of Jiyeh (2016a: 104). Additionally, a Sidon 3 amphora, the predecessor of the Beirut Type, was identified, also likely produced in Jiyeh. However, the data of the Hellenistic and Roman ceramics from Sidon is not comprehensively quantified and requires further examination.

The Beirut Type has been noted elsewhere in the south along the coast, as seen in the few sherds observed at Damour, though these have not been dated (personal communication with Stephen McPhillips, identification by Hanna Hamel). Further south, Beirut amphorae are quite rare at Tyre based on recent excavations, with only Byzantine forms having been identified thus far (Gatier et al. 2011: 66). Recent excavations have focused on the urban centre, specifically the baths and cathedral, which revealed a selection of primarily local amphorae, along with southern Levantine imports (Gatier et al. 2011). A small amount of Beirut Type sherds was uncovered, dating roughly to the 5th century AD, but no further quantifications or specifications have been given (Gatier 2011: 1553).

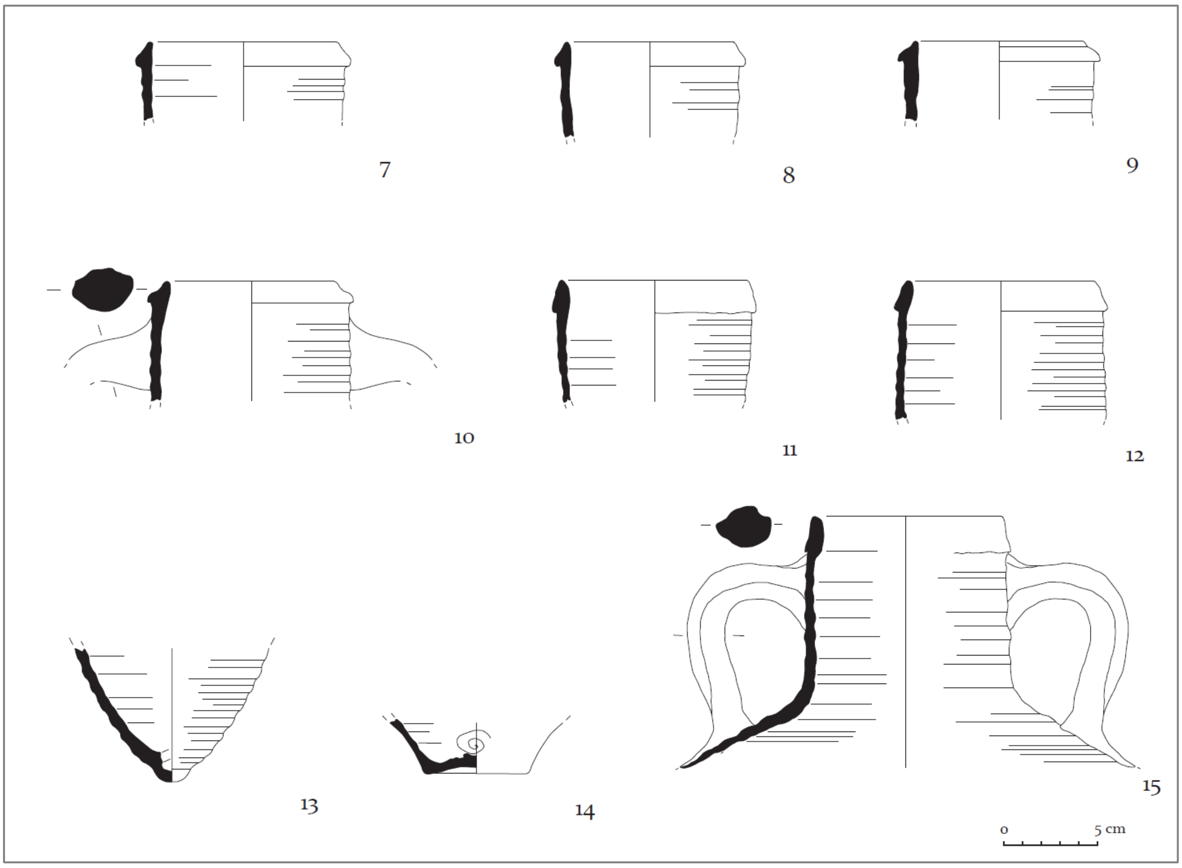

Figure 7.3: Beirut Type 2 amphorae uncovered in Sidon (7-13 and 15) (after Wicenciak 2016b: 104, Fig. 5-2)

The contrast between the distribution of Beirut Type 2 and 3 is notable, with the former having been identified throughout the region between Sidon and Beirut, and the latter being noticeably absent (apart from Jiyeh). However, it must be recalled that Jiyeh and Khalde represent production centres and not distribution targets. Thus, the only true importers of Beirut Type 2 are Sidon and inland in Chhîm (though production of the type in Sidon is a possibility; Wicenciak 2016b). These patterns might suggest that the form packaged an agricultural product consumed primarily in the local area around Beirut. Beirut Type 3 does not seem to have been distributed in any significant capacity in Lebanon apart from Jiyeh, and might have been intended for consumption within the city of Beirut itself and at sites in the wider region.

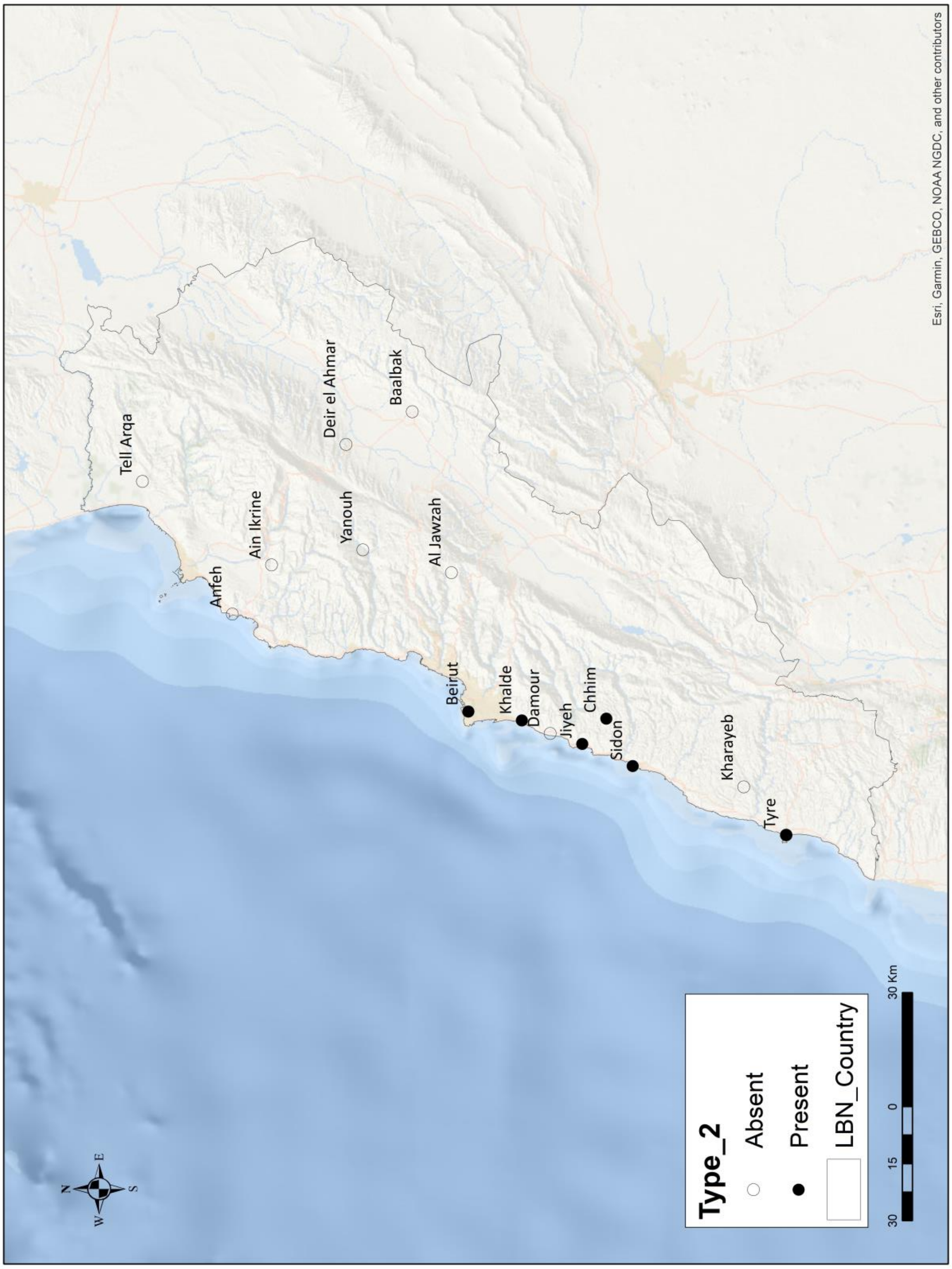

Figure 7.4: Distribution map of the Type 2 amphora in Lebanon

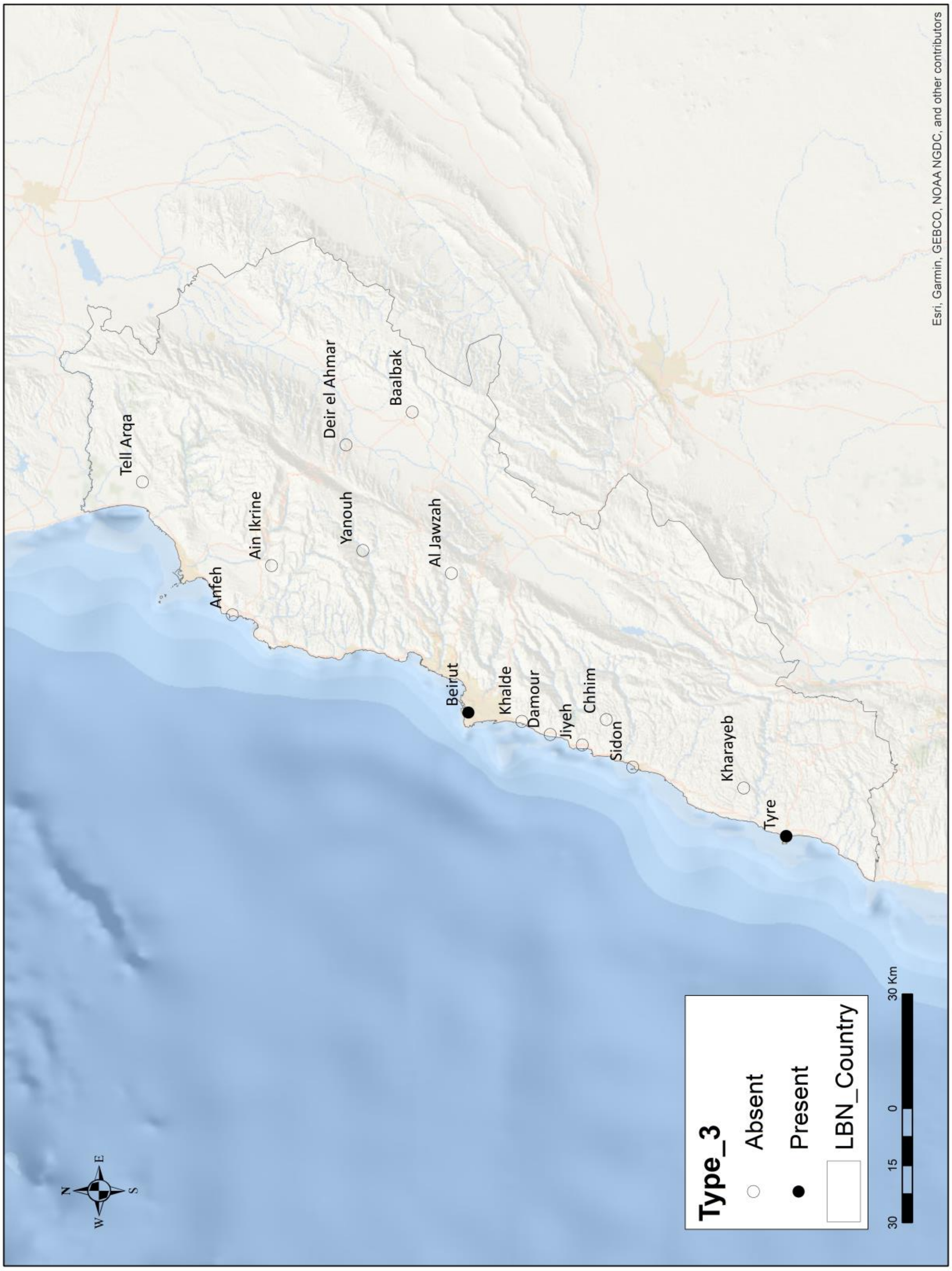

Figure 7.5: Distribution map of the Type 3 amphora in Lebanon

Chhîm is a rare example of a fairly well-explored site in the hinterland of the south, revealing extensive oil and wine press installations from the early Imperial period to the Byzantine period (Waliszewski 2006). Interestingly, Beirut Type 2 amphorae, either produced in Beirut or Jiyeh, were uncovered in the early Roman vessel assemblage from Chhîm (Waliszewski and Wicenciak 2015: 380; Wicenciak 2016a: 111). In the late Roman and Byzantine periods, AM 14 and Agora

M334 amphorae appear to have been transported from Jiyeh to Chhîm (Wicenciak 2016b). Additionally, Chhîm seems to have produced its own type of amphora, which shares characteristics with the Beirut amphora in its rim, handle and button base of the Beirut Type 2. The bag-shaped body seems to more closely resemble the 'classic' Palestinian form.

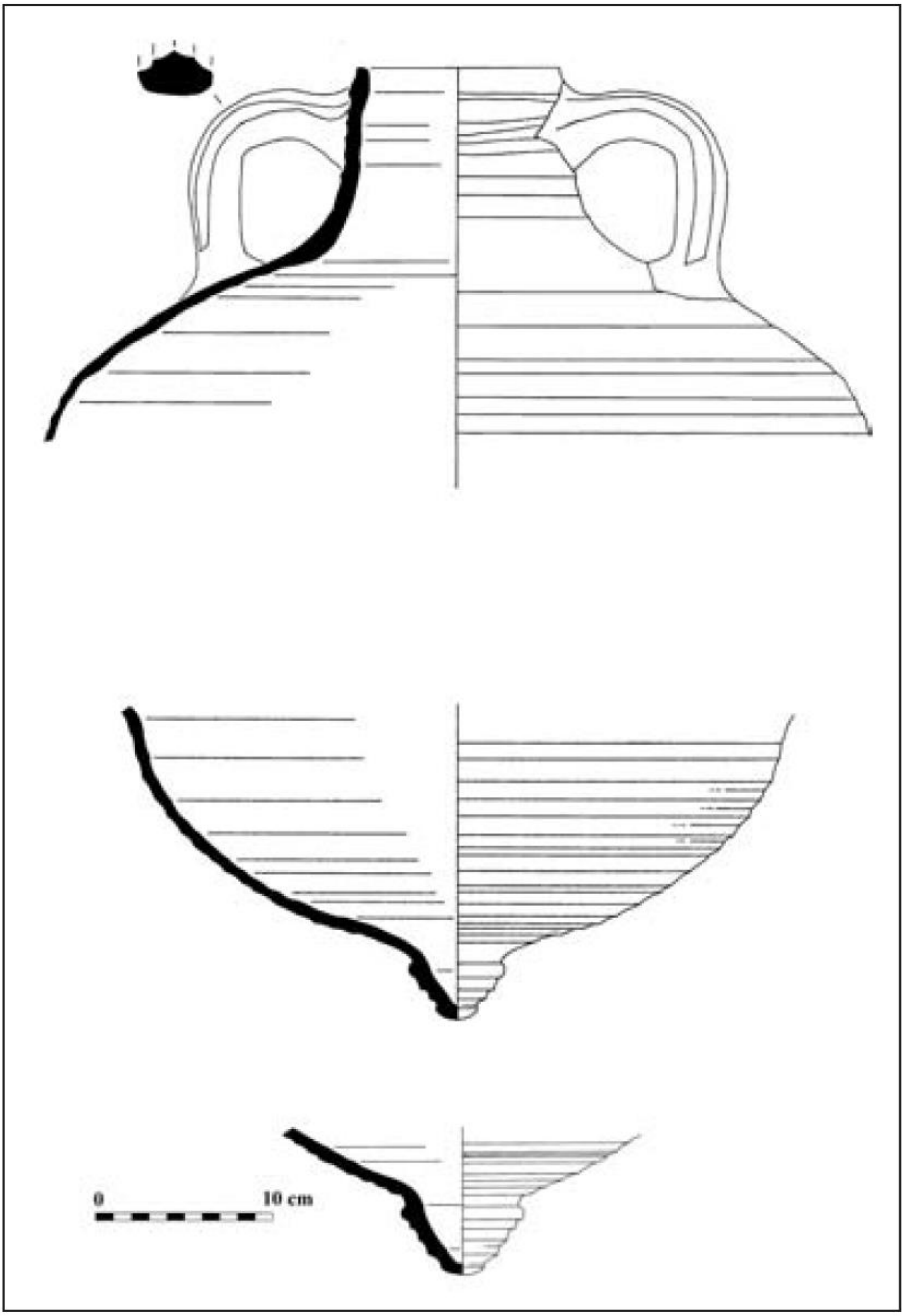

Figure 7.6: The Chhîm amphora, bearing some resemblance to the Beirut amphora (rim) and Palestinian-style amphora (body) (after Reynolds 2008: 78, Fig. 5)

7.1.3 Discussion

Overall, Beirut Type amphorae are quite rare at Lebanese sites, with the highest concentration appearing in the Imperial period in southern Lebanon. The form is rarely transported inland, only appearing in Chhîm in the Imperial period, and Al Jawzah and Ain Ikrine in the Byzantine period. This permeation inland in later periods also continues up to the 12th century AD, as attested in the high frequency of ceramics from Beirut observed in Al Jawzah (Nacouzi et al. 2004: 253). However, there is a definite need for further survey inland, especially around prevalent terrestrial routes connecting *Berytus*'s hinterland with the urban centre. Considering the trend between Baalbek and Beirut, indicating a one-directional flow of products from Baalbek to Beirut, it is necessary to consider transit sites along this route to see where the reciprocity ends.

7.2 Distribution in the Eastern Mediterranean

As discussed in Chapter 4, a selection of port sites along the Levantine and Cypriote coasts has been compiled to trace the distribution of the Beirut Type. Outside Lebanon, the Beirut Type appears sporadically at a number of sites, with a wide range but in low volumes. This is depicted in Figure 7.8 and Figure 7.10, which show the low frequency observed at the sampled port sites (always below 5% of the total assemblage of amphorae). In this section, only Beirut Types 2, 3, 5, and 8 are discussed, as the Beirut Type 1 identifications are preliminary, while Beirut Types 4, 6, and 7, are completely absent outside Beirut.

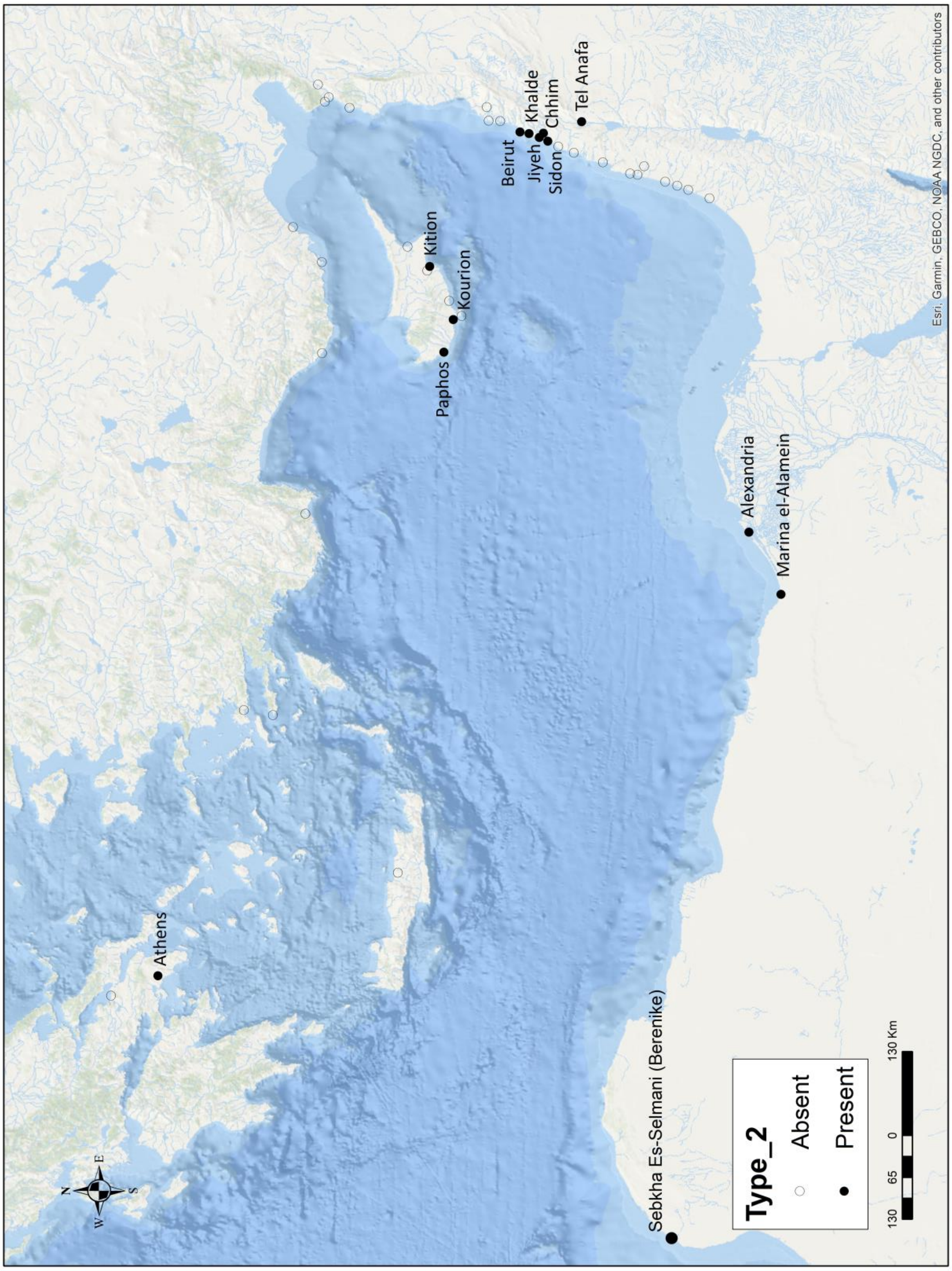

Figure 7.7: All instances of the Beirut Type 2 amphora in the eastern Mediterranean (P/A)

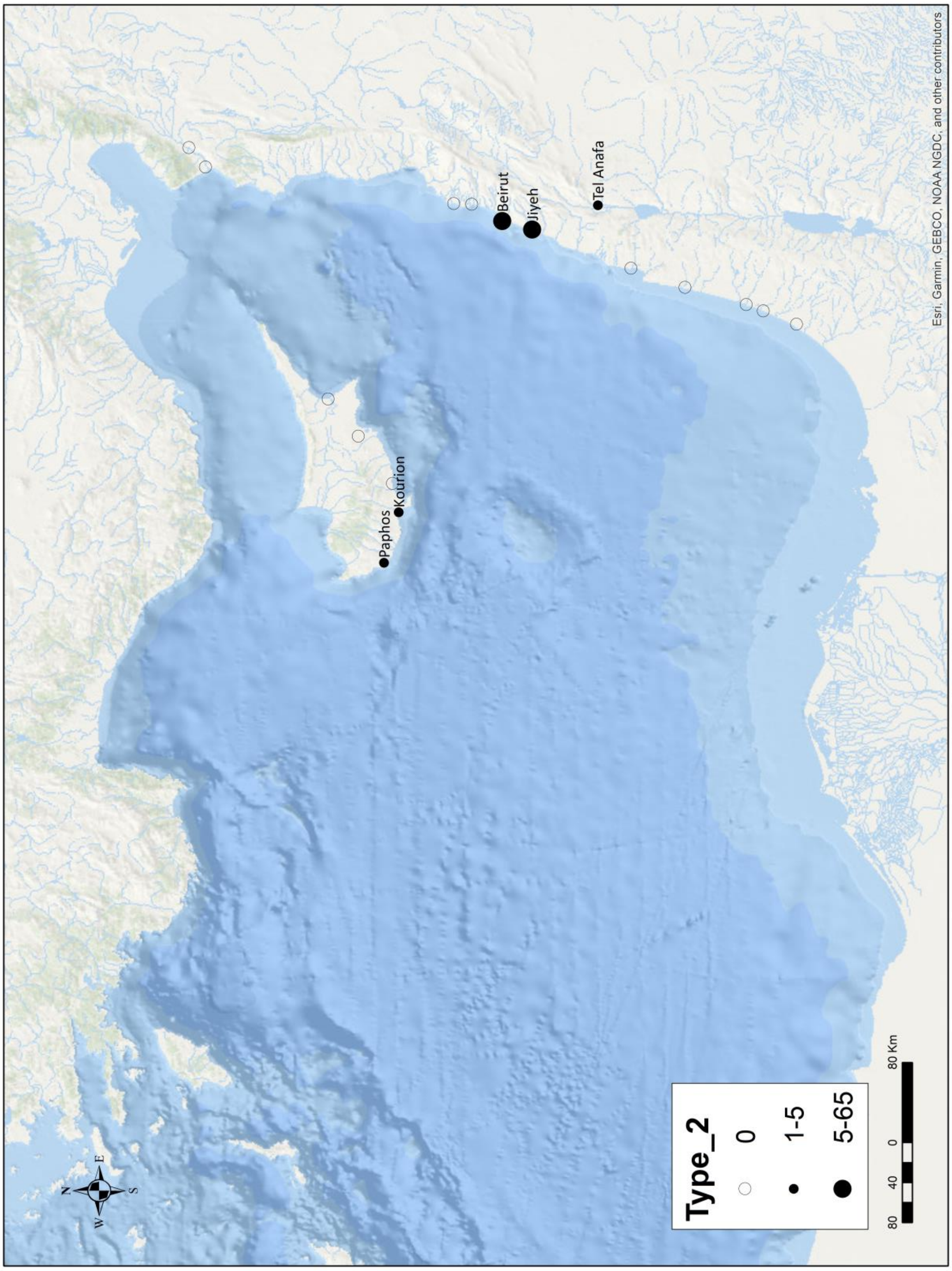

Figure 7.8: Beirut Type 2 distribution based on percentage of total amphora assemblage at site

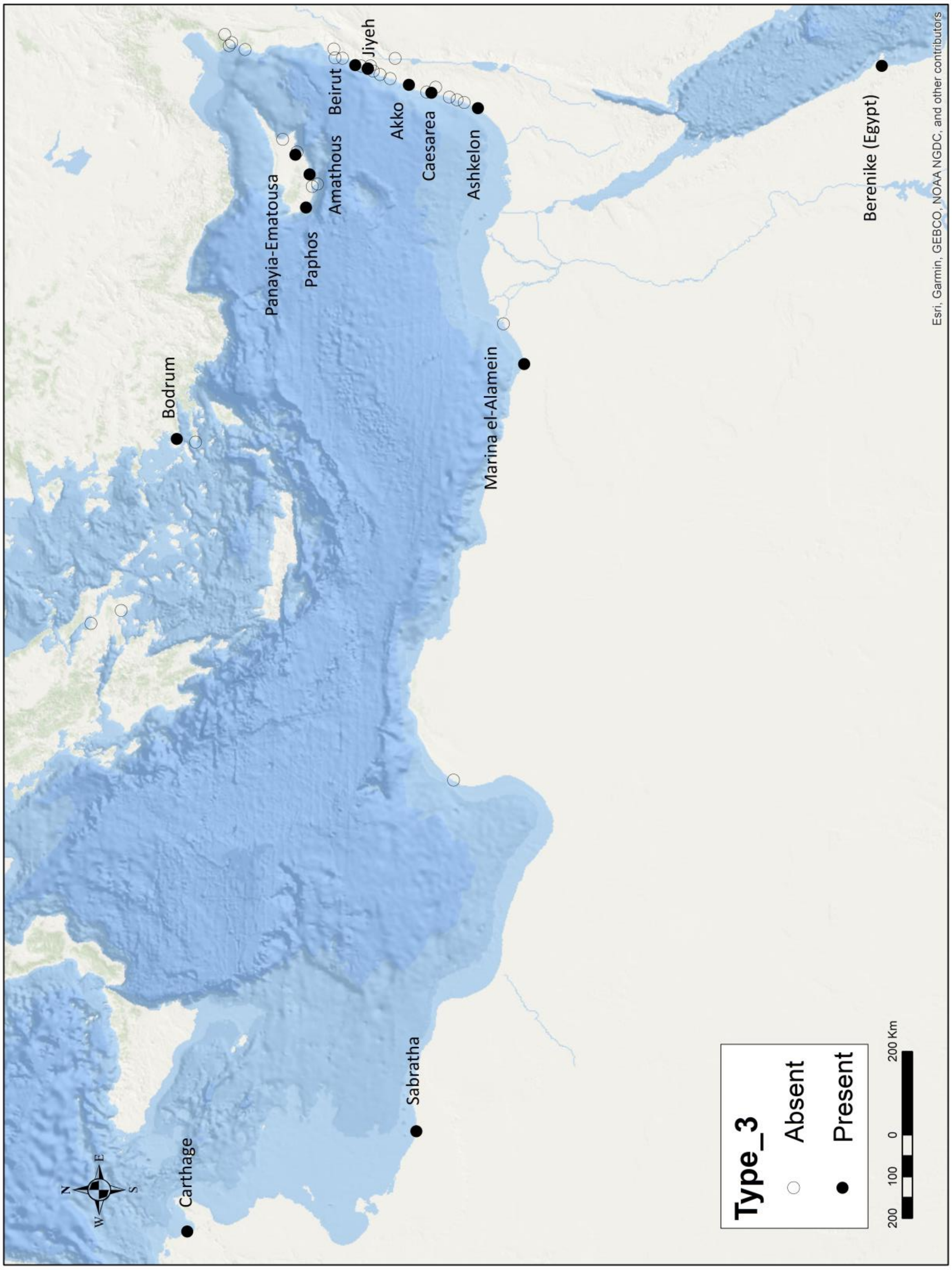

Figure 7.9: All instances of the Beirut Type 3 amphora in the eastern Mediterranean (P/A)

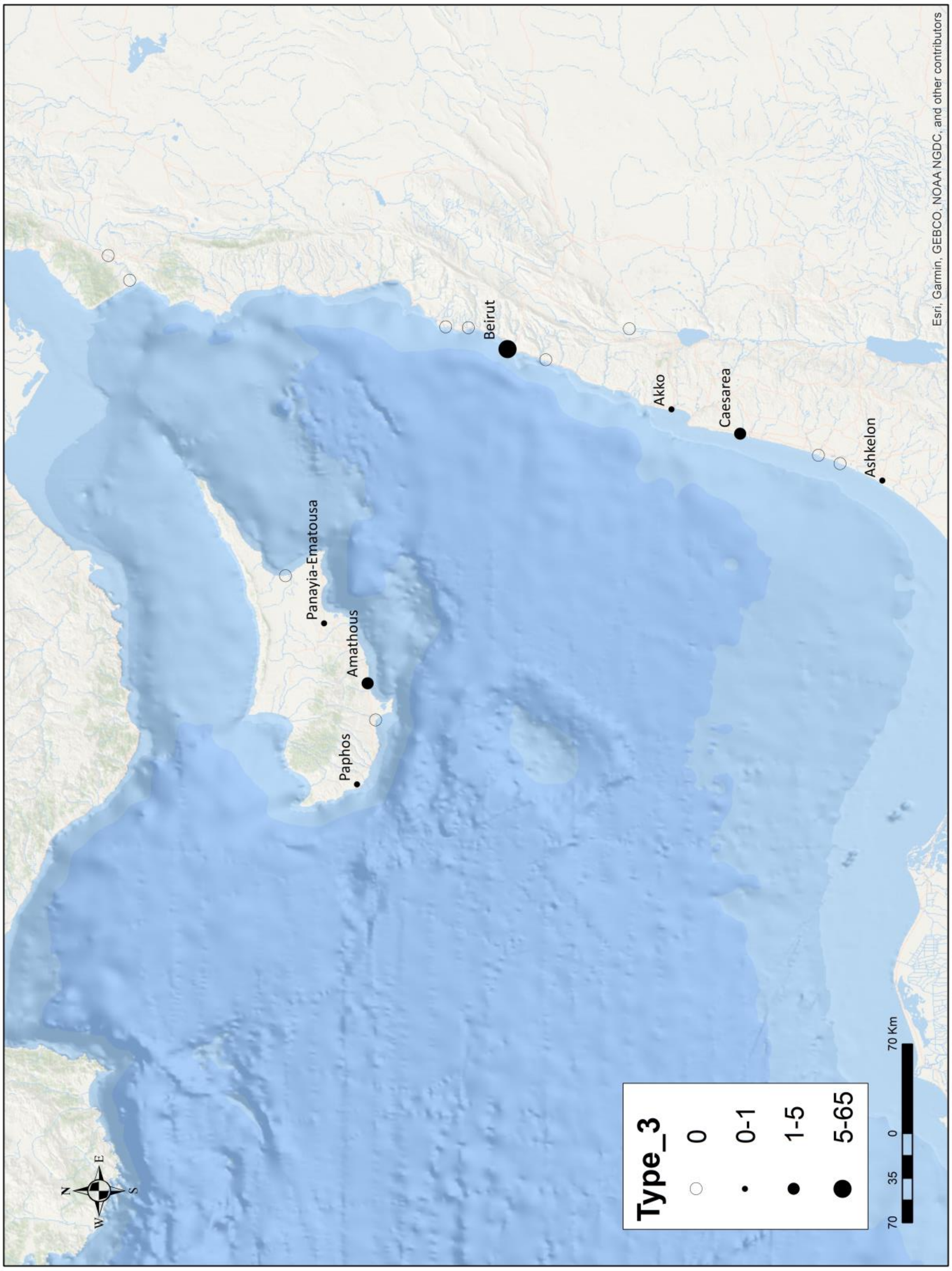

Figure 7.10: Beirut Type 3 distribution based on percentage of total amphora assemblage at site

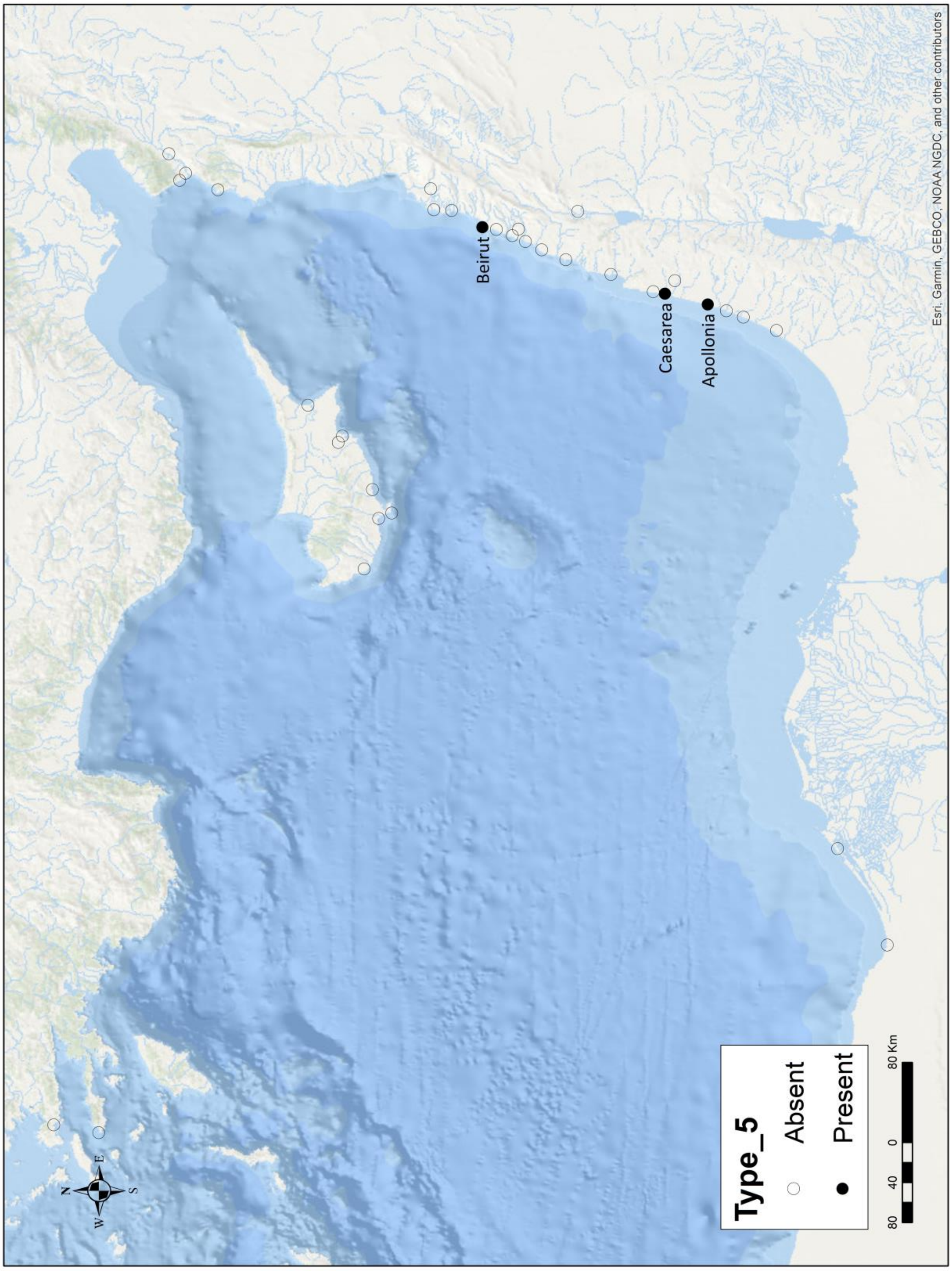

Figure 7.11: All instances of the Beirut Type 5 amphora in the eastern Mediterranean (P/A)

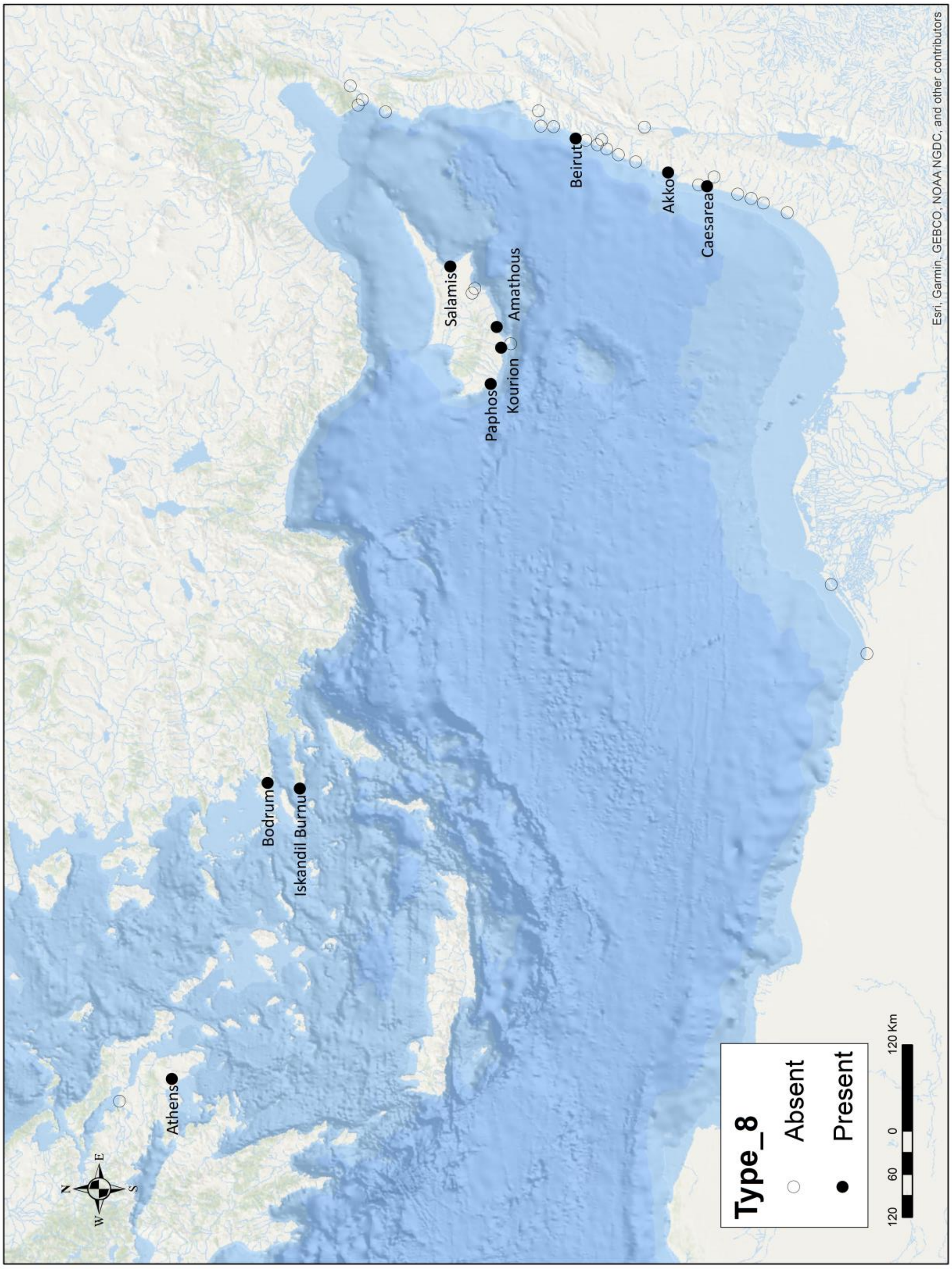

Figure 7.12: All instances of the Beirut Type 8 amphora in the eastern Mediterranean (P/A)

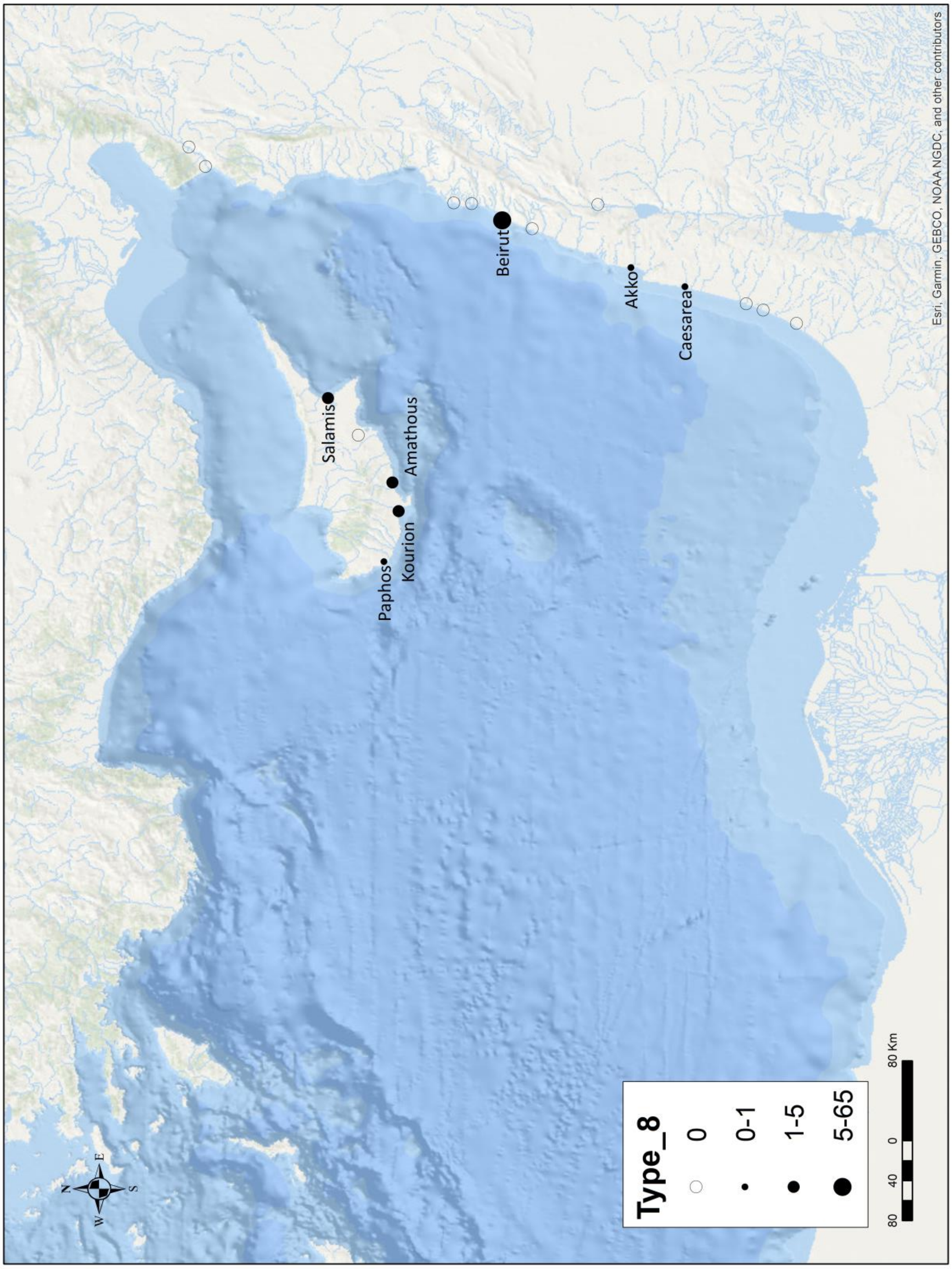

Figure 7.13: Beirut Type 8 distribution based on percentage of total amphora assemblage at site

Site	1	2	3	4	5	6	7	8	Carrot	AM 72	Unspecified	Source
Ain Ikrine	0	0	0	0	0	0	0	0	0	0	1	
Akko	0	0	1	0	0	0	0	1	0	0	0	

Alexandria	0	1	0	0	0	0	0	0	0	0	0	Wicenciak 2016a: 656
Al-Mina	0	0	0	0	0	0	0	0	0	0	0	
Amathous	0	0	1	0	0	0	0	1	0	0	0	
Antioch	0	0	0	0	0	0	0	0	0	0	0	
Apamaea	0	0	0	0	0	0	0	1	0	0	0	Viviers and Vokaer 2008: 133
Apollonia	0	0	0	0	1	0	0	0	0	0	0	
Ashkelon	0	0	1	0	0	0	0	0	0	0	0	
Athens	0	1	0	0	0	0	0	1	0	0	0	
Beirut	1	1	1	1	1	1	1	1	1	1	0	
Berenike (Egypt)	0	0	1	0	0	0	0	0	0	0	0	Hayes 1996: 159
Bodrum	0	0	1	0	0	0	0	1	0	0	0	
Caesarea	0	0	1	0	1	0	0	1	0	0	0	Blakely 1987: 44, Fig. 16.30; Tomber 1999: 299, Fig. 6.1
Cape Zevgari	1	0	0	0	0	0	0	0	0	0	0	
Carthage	0	0	1	0	0	0	0	0	0	0	0	
Chhim	0	1	0	0	0	0	0	0	0	0	0	Wicenciak 2010: 887
Horbat Biz'a	0	0	0	0	0	0	0	0	0	1	0	
Iskandil Burnu	0	0	0	0	0	0	0	1	0	0	0	
Jaffa	0	0	0	0	0	0	0	0	0	0	0	
Jiyeh	0	1	1	0	0	0	0	0	0	1	0	
Khalde	0	1	0	0	0	0	1	0	0	0	0	
Kition	0	1	0	0	0	0	0	0	0	0	0	
Kourion	0	0	1	0	0	0	0	1	1	0	0	
Marina El-Alamein	0	1	1	0	0	0	0	0	0	0	0	
Panayia-Ematousa	0	0	1	0	0	0	0	0	0	1	0	
Paphos	1	1	1	0	0	0	0	1	0	0	0	
Posideion/Ras el Bassit	0	0	0	0	0	0	0	0	0	0	0	
Sabratha	0	0	1	0	0	0	0	0	0	0	0	
Salamis	0	0	0	0	0	0	0	1	0	0	0	
Sebkha Es-Selmani (Berenike)	0	1	0	0	0	0	0	0	0	0	0	
Seleucia Pieria	0	0	0	0	0	0	0	0	0	0	0	
Sidon	0	1	0	0	0	0	0	0	0	0	0	
Tel Anafa	0	1	0	0	0	0	0	0	0	0	0	

Tyre	0	0	0	0	0	0	0	0	0	0	1	
Yavneh-Yam	1	0	0	0	0	0	0	0	0	0	0	

Table 7.1: Distribution of all Beirut Types at chosen Roman ports and associated sites along the Levantine and Cypriot coasts based on presence/absence

Site	Context	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8
Akko		0.0	0.0	**0.6**	0.0	0.0	0.0	0.0	**0.4**
Amathous	*Agora (early)*	0.0	0.0	**4.0**	0.0	0.0	0.0	0.0	0.0
	Agora (late)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2.3**
	Palaea Lemesos	0.0	0.0	**0.4**	0.0	0.0	0.0	0.0	0.0
Antioch		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apollonia		0.0	0.0	0.0	0.0	**3.4**	0.0	0.0	0.0
Ashkelon		0.0	0.0	**0.6**	0.0	0.0	0.0	0.0	0.0
Caesarea	*Harbour*	0.0	0.0	0.0	0.0	**?**	0.0	0.0	**0.9**
	Area LL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vault 1	0.0	0.0	**5.0**	0.0	0.0	0.0	0.0	0.0
	Late Byzantine Building	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.5**
Jaffa		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jiyeh		0.0	**40.0**	**?**	0.0	0.0	0.0	0.0	0.0
Kourion	*Early*	0.0	**0.9**	0.0	0.0	0.0	0.0	0.0	0.0
	Late	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1.4**
Panayia-Ematousa		0.0	0.0	**1.2**	0.0	0.0	0.0	0.0	0.0
Paphos	*SK Castle*	**1.0**	**2.0**	**1.0**	0.0	0.0	0.0	0.0	**0.3**
	House of Orpheus	0.0	0.0	**1.9**	0.0	0.0	0.0	0.0	0.0
	Theatre (early)	0.0	0.0	**0.8**	0.0	0.0	0.0	0.0	0.0
	Theatre (late)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.9**
Salamis		0.0	0.0	0.0	0.0	0.0	0.0	0.0	**4.0**
Tel Anafa		0.0	**2.2**	0.0	0.0	0.0	0.0	0.0	0.0
Yavneh-Yam		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Limyra		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aphrodisias		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Elaiussa Sebaste		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Antiochia Ad Cragum		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7.2: Distribution of all Beirut Types at quantified contexts with frequencies based on total sherd count

7.2.1 The Southern Levant and Egypt

7.2.1.1 Ashkelon

The site of Ashkelon served as a commercial seaport during the Roman period, well-known for its international trade fairs and busy agricultural markets (Stager and Schloen 2008: 9). In a region that is quite dry with minimal rainfall, Ashkelon benefitted from a number of wells that provided fresh water for drinking and irrigation, making it a strategic settlement along the southern-most extent of the Levantine coast. Thus, despite its seaport possibly remaining unsheltered from the dominant winds and wave action, the ceramic assemblage uncovered reflects a wide range of sources in the early Roman period, followed by a rise in the frequency of local types in the late Roman and Byzantine periods (Stager and Schloen 2008: 9). Surrounding sites corroborate this increase in regional production (Rapuano 2012: 21).

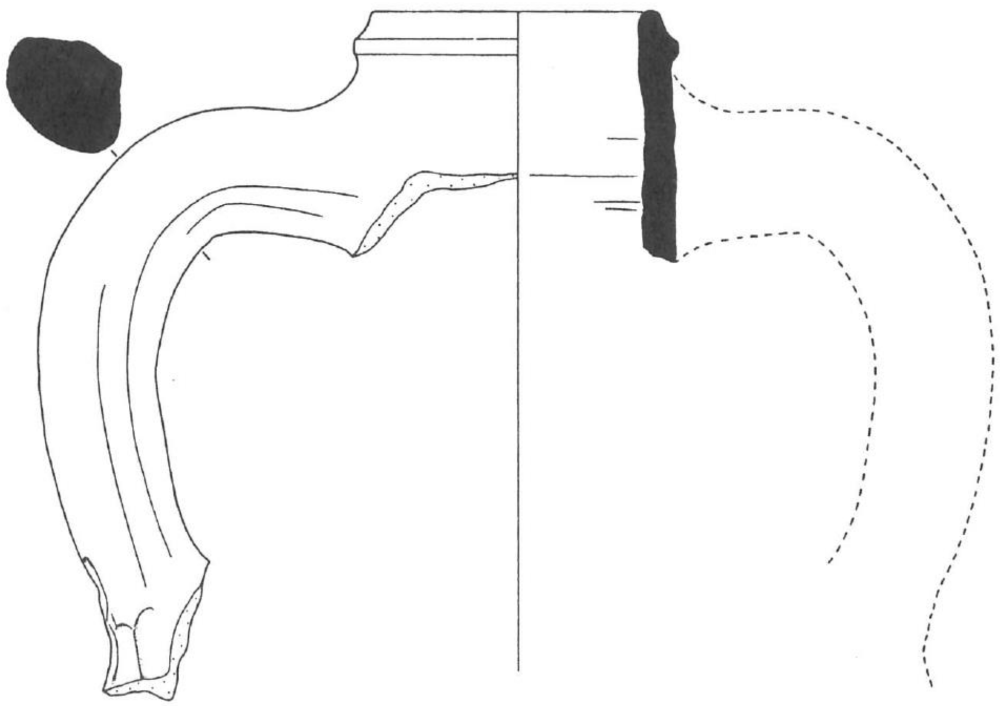

Figure 7.14: Upper body of a Beirut Type 3 found in Ashkelon (after Johnson 2008a: 152)

The studied amphora data comes from land excavation of the coastal site, found in the 1985-88 seasons. At Ashkelon, the most extensive ceramic report regarding the Hellenistic, Roman and Byzantine periods focuses on imported material (Johnson 2008). Thus, the quantified assemblage discussed does not take into account local material. There does not seem to have been any dominant form, with a variety of types being observed at Ashkelon from Africa, Italy, Greece, Egypt, Asia Minor, Cyprus, Spain and the Levant (Table 10.10). Among this assemblage, one Beirut Type 3 handle was observed, representing 0.6% of the total assemblage (MNI) (Figure 7.14). Another Beirut product (or north Lebanese) is suggested by a possible AM72 sherd (Johnson 2008a: 159; Reynolds 2003: 123, Fig. 8-9). While this is hardly evidence to suggest a significant commercial connection, it does show that the Beirut Type did, in fact, reach the southern-most point of the Levantine coast. Furthermore, no amphora quantity exceeded 5% of the total assemblage from a sample of 175 amphorae (Johnson 2008); thus, the Beirut Type 3 sherd represents one of many infrequent types observed at Ashkelon.

7.2.1.2 Yavneh-Yam

The coastal site of Yavneh-Yam is located between Jaffa and Ashkelon, with the primary periods of occupation in the Iron Age to the late Hellenistic period (Fischer 2002: 48). Though it is referred to as a village by Strabo (16.2.28), it appears to have been heavily populated based on rural settlements (Fischer and Taxel 2007: 221). Recent excavations have focused primarily on pre-Roman periods, though ceramic reports have suggested significant commercial activity in the Roman period when the site emerged as another prosperous centre along the southern Levantine coast (Jakoel 2015). In this way, Yavneh-Yam appears to have been a notable port site with an interconnected hinterland (Fischer and Taxel 2007). Similar to other southern Levantine sites, it experienced significant urban expansion and increased rural settlement in the Roman and Byzantine periods (Fischer et al. 2008).

The assemblage analysed at Yavneh-Yam is not quantified, and the percentages given here are based on the material included in the ceramic publication. It appears that a portion of the assemblage has been excluded from analysis, as attested by the fact that the author claims a high quantity of African imports, but only one is actually specified in the published report (Jakoel 2015: 39). Of note is the possible Beirut 1A/Sidon 3 amphora that has been identified as a Crétoise 3 form (Jakoel 2015: 38-9), which represents 5% of the total assemblage. However, this identification is still tentative and has not been included in network analysis models in this thesis. Sixteen other storage jars were assessed in the report, some of which appear to be Almagro 54 forms, dated by excavators to the 1st to 3rd centuries AD (Jakoel 2015). Thus, it can be asserted that local forms might have been prevalent in the Roman and Byzantine periods.

7.2.1.3 Jaffa

Jaffa rose to prominence as a port city at least by the beginning of the Middle Bronze Age (Burke et al. 2017). In the Roman period, specifically just before 70 AD, it is believed that the harbour basin utilised in previous periods went out of use based on geomorphological analysis, with ships possibly taking shelter in a smaller anchorage on the northern side of the site (Burke et al. 2017: 107). Though this has often been attributed to the rise of Caesarea, leading to the demise of other southern Levantine port sites, this is not supported by the ceramic evidence. As seen in recent analysis, the port continued to import products packaged in a variety of amphora forms (Gendelman 2018).

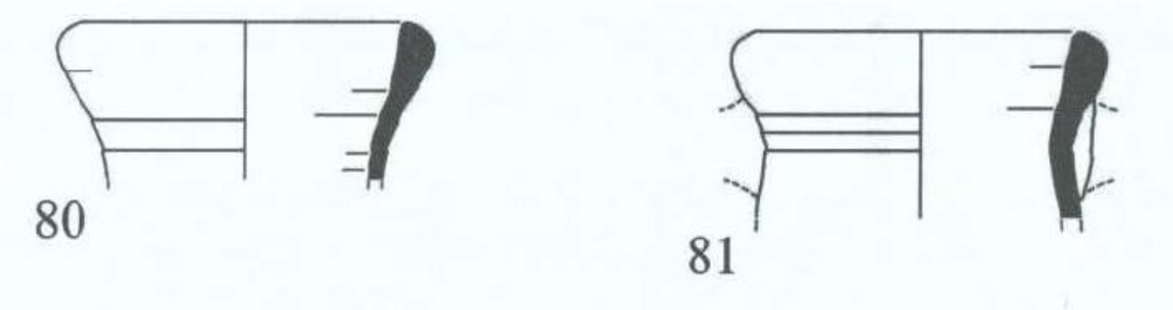

Figure 7.15: Possible AM 72 sherds identified from the ceramic assemblages of Jaffa (after Gendelman 2018: 443, Fig. 10.6)

The assemblages analysed come from a residential context (Early-Mid Roman period) and a refuse pit (3rd-4th AD), with a total of 99 amphora sherds (Gendelman 2018: 417). Though the author does not contextualise the samples, the complete lack of local material suggests that the report probably only considers imports, both regional and distant. This is supported by the brief discussion of local material uncovered at the site in another chapter of the same publication (Tsuf 2018). Jaffa appears to have remained quite well-connected in the Roman period, importing material from Cyprus, the Levant, Egypt and a variety of sites across the western Mediterranean (Gendelman 2018: 417-29). Among this varied assemblage, no Beirut Types have been observed. Two specimens might be examples of the AM 72 form (Gendelman 2018: 443, Fig. 10.6.80-81), though this is difficult to confirm given that the type is still not well-understood (Reynolds 2005; Wicenciak 2016a). Furthermore, it is impossible to specify whether these might have been produced in Beirut or northern Lebanon. Thus, despite its well-connectedness, Jaffa does not appear to have imported agricultural products packaged in the Beirut Type in any significant quantity.

7.2.1.4 Apollonia

Apollonia, located between Caesarea and Akko, is the only major maritime centre of the southern Sharon Plain throughout Antiquity. Apollonia provides an interesting comparative example, because the city seems to have declined based on ceramic imports/exports and urban construction in the Roman period after the establishment of Caesarea as capital of the Roman colony (Roll and Tal 2008: 134). Land excavations have not yet resulted in publications of the

Roman ceramics, though a Roman villa (1st-3rd AD, reutilised in the Byzantine period as a wine press) has been identified near the coast (Roll and Tal 2008: 136). A number of local amphorae appear to have been uncovered there, including Almagro 54, LRA 5 and 6, and possibly some N. African imports (identified on photo on website).

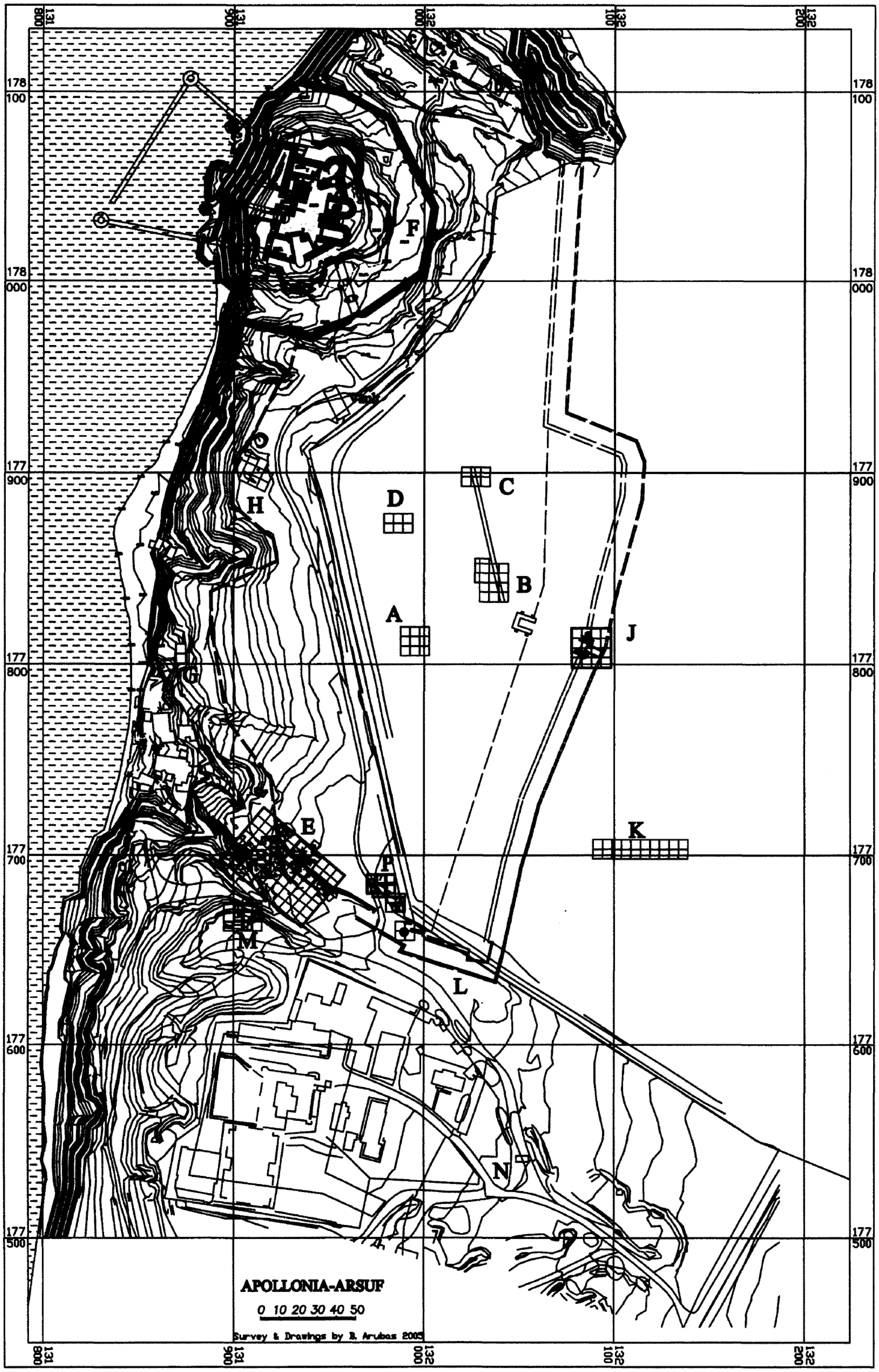

Figure 7.16: Site plan of the terrestrial excavations at Apollonia; the Roman villa is situated in Area E (after Roll and Tal 2008: 135, Fig. 1)

Underwater surveys were undertaken just west of Area F (Figure 7.16) which uncovered 29 amphorae (D.1.4), the majority of which are of the LRA 5 type, and dated roughly to the 6th-7th AD (Grossmann 2001: 81-93). Almagro 54 follow at 17.2% of the total assemblage, dated to the 4th-7th AD. Among this assemblage, one possible Beirut Type 5 was identified, though it is difficult to definitively identify it as Beirut Type 5 because the rim is missing, which is the primary way of differentiating Beirut 5 from Beirut 7. The overall shape seems to match Beirut 5 more closely, so it has been specified as such. Additionally, a Mauretanian amphora, an unknown Baetican amphora, and an LRA 1 amphora were observed among the imported vessels, with 6 unidentified types. The Beirut Type again represents below 5% of the amphora assemblage (3.4%). Its presence here is especially interesting since 65.5% is local (mostly LRA 5 amphorae produced in the hinterland; Erlich 2017), and 24.4% is unidentified, indicating that the Beirut Type is a rare import in this assemblage. It is unclear whether this assemblage is related to the Roman villa in the southern extension of the site.

7.2.1.5 Caesarea

Caesarea was probably the largest and most commercially active maritime site in the southern Levant throughout the Imperial period (Raban 1992). It was built on the remains of Straton's Tower, a trading station possibly erected by the King of Sidon (Jos. *Ant.* 15.8.5; Raban 1989: 25; 2009: 15). Herod expanded the Hellenistic site over twelve years from 22-10/9 BC, creating a key Roman port site in a relatively unsheltered location. Due to this lack of natural protection, the harbour required constant upkeep and a significant investment, as suggested by the monumental breakwaters reinforced with underwater concrete (Oleson 1988: 152). The harbour flourished for some time, but it seems that it fell into disrepair with its incorporation into the Roman state and characterisation as a municipal harbour sometime around 70 AD (Raban 2009: 204). However, the harbour was still used continuously throughout the Roman period, and the city continued to prosper based on ceramic, numismatic and literary evidence, though the peak of economic activity seems to have been in the mid-1st century AD (Blakely 1988: 327-46; Patrich 2011: 122-3, 126; Raban 2009: 204-6; Tsori 1977). Despite sediment accumulation and structural displacement due to tectonic activity, the harbour continued to serve merchants travelling to and from Caesarea throughout the Roman and Byzantine periods (Raban 2009: 204-6).

The amphora assemblage at Caesarea is difficult to quantify, as a number of ceramic analyses have been conducted over the years by different scholars, each with different methods and typologies (Berlin 1992; Blakely 1992; Oleson et al. 1994; Oren-Paskal 2008; Riley 1975; Tomber 1999). Two assemblages have been chosen here (D.1.6), one from the harbour that has been quantified by the excavators and only requires a revision based on typologies created over the past 25 years (Oleson et al. 1994), and one from a storage facility that has been quantified in this study by classifying vessels more specifically and compiling comprehensive statistics (Oren-Paskal 2008). The storage building (Area LL) sheds light on a warehouse's assemblage, while the harbour contexts (Area I14) provide ceramic vessels probably more characterised with ship cargoes. Several other reports have been reviewed by the author in search of Lebanese types (Adan-Bayewitz 1986; Blakely 1992; Berlin 1992; Riley 1975; Tomber 1999: 297-9) without a full quantification, either due to the lack of sherd or MNI counts or a highly-selective analysed assemblage. They are briefly discussed in this section, but have not been compiled in the appendix.

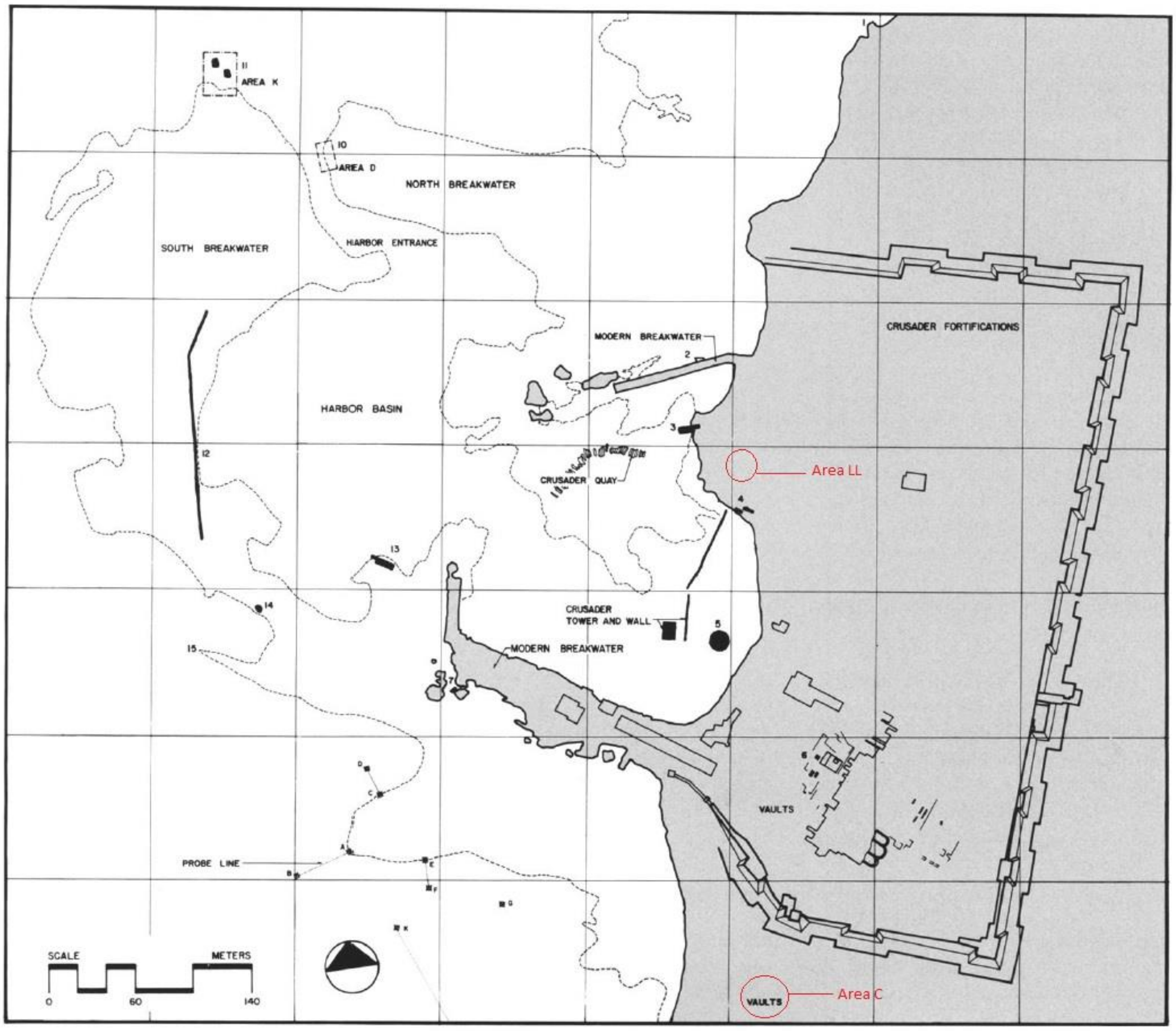

Figure 7.17: Caesarea Maritima with selected assemblages (in addition to general sampling of harbour) (after Hohlfelder et al. 1983: 135)

The first assemblage comes from Area LL, the warehouse quarter from the 1995-2007 seasons. The context reflects continuous occupation from the 3rd century BC to 1291 AD, though the Hellenistic occupation layers have not revealed significant remains apart from fill layers (Stabler et al. 2008: 1-17). It appears that some sort of storage facility was built in Herod's time, with another warehouse constructed around 400 AD (Stabler et al. 2008: 1). Unfortunately, the main analysed assemblage only comes from the abandonment layer in 640 AD, with the Roman period poorly represented (Oren-Paskal 2008: 49). Regardless, the frequencies mirror the overall trends observed from other publications and can be taken as a representative sample of the region for the Late Roman and Byzantine periods (Oren-Paskal 2008: 58).

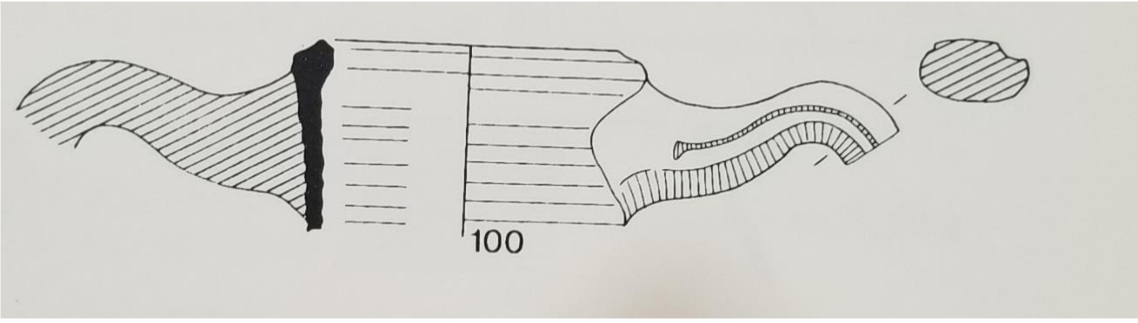

Figure 7.18: An example of the Beirut Type 5 amphora; this specimen was found in Caesarea (after Tomber 1999: Fig 6.1)

The warehouse assemblage is dominated by LRA 5 and Almagro 54 amphorae, with no Beirut Types observed (Table 10.11). Area I14, the inner harbour excavated as a sondage in 1993, revealed a similar pattern to Area LL (Table 10.12). This assemblage has not been quantified, but one of the specimens is a sherd of the Beirut Type 5 (Tomber 1999, Fig. 6.1). In Area C, a vault area in the southern part of the site, the patterns observed at Area LL and Area I14 remained consistent, with the majority of specimens being LRA 5, and the bulk of imports come from the Aegean, Asia Minor and the Palestinian coast (Blakely 1987). A possible Beirut Type 3 rim was observed (Blakely 1987: 44, Fig. 16.30), which represents 5% of the assemblage assessed in the associated context. Two diagnostic Beirut Type 8 sherds were observed at Caesarea in a Byzantine building in the southern area of the site. Though an Egyptian origin is suggested by excavators (Adan-Bayewitz 1986: 124, Fig. 2: 13-14), these are surely examples of Beirut 8.2, dated to the mid-7th century AD. They represent roughly 1.5% of the entire assemblage of amphorae sherds uncovered from the context.

7.2.1.6 Dor

The port city of Dor was a dominant maritime presence in the Hellenistic period, to the extent that it actually repelled Antiochus III in the Seleucid campaigns in 219 BC (Stern 1996a: 3). In 63 BC, Pompey refounded Dor as a part of Roman Syria and granted it autonomy (Stern 1996a: 3-4). After the establishment of Caesarea, Dor experienced less maritime traffic (similar to Akko), especially in the late-4th century AD, when the site appears to have been partially deserted (Stern 1996a: 355).

No Lebanese amphorae were observed after a review of ceramic reports from excavations at Dor (Stern 1996b). I have opted not to conduct a thorough quantification of the amphora assemblage since the amphorae are interspersed throughout each of the publications without an attribution of vessels with specific contexts (Stern 1996b: 183, 289), and a full statistical analysis is outside the scope of this thesis. Based on preliminary examinations, the port seems to have been most active in the Iron Age and Hellenistic periods, declining into the early Roman period (Stern 1996b: 216), but a strict quantification of amphorae found at Dor is still needed.

7.2.1.7 Akko (Ptolemais)

Akko has served as an anchorage or harbour since the Bronze Age (Galili et al. 2010: 192-3). In the Roman period, Josephus mentions the site as an important militaristic and political centre, especially under Vespasian (Jos. *Bell*. 3.2, 3.4, 3.6; Kashtan 1988). Around 51-54 AD, Roman veterans were settled in the region and a colony was established (Campbell 2000: 334-5; Kadman 1961: 52). At this time, the port appears to have been quite active, as shown by archaeological remains and a Roman shipwreck uncovered in the western harbour basin (Galili et al. 2010: 197-8; Rosen et al. 2012: 171).

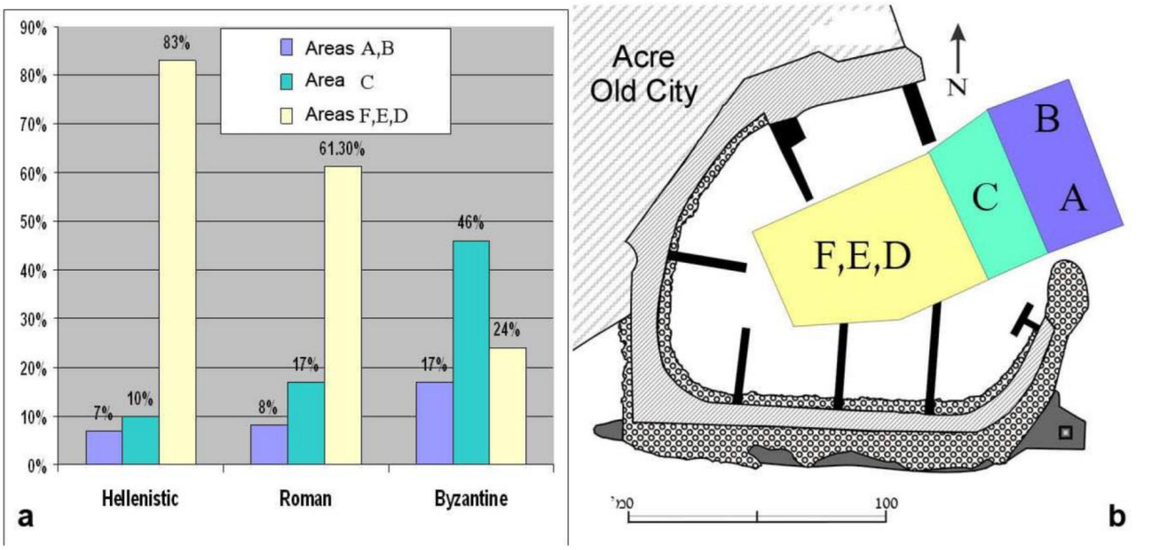

Figure 7.19: Depiction of the artificial harbour with various frequencies of archaeological finds; the higher frequency of finds towards the outer part of the basin in later periods is suggestive of sedimentation and an infilling of the harbour over time (after Galili, Rosen, Stern et al. 2007: 65, Fig. 2).

Two main assemblages were analysed for the site of Akko, one from the Courthouse Site and the Hospitaller Compound, and another from the amphora assemblage of the Akko Marina Archaeological Project (Table 10.3). The former is dated to the Hellenistic-Early Roman period, with an assemblage dominated by Rhodian amphorae (3rd-1st BC) and Phoenician Baggy Jars

(3rd-1st BC), possibly produced in Tyre (Hartal et al. 2016). The second assemblage, taken from excavations at the Akko Marina, provides a more encompassing view of commercial patterns. There are two main peaks in ceramic densities: one in the Hellenistic period and one in the Byzantine period (Silberstein et al. 2017). The first peak can be correlated with the stationing of troops by Ptolemy IV in Akko around 210-205 BC, as suggested by the stamped amphora handles (Ariel 2005: 181). At this time, imports were almost exclusively Rhodian or from the local region. In the early Roman period, the total quantity of sherds decreases, possibly correlated with the rise of Caesarea and the subsequent decrease in traffic at Akko (Galili et al. 2010: 203). Over time, Levantine imports increased progressively, representing roughly 16% of imports in the Roman period, and 40% in the Byzantine period (Galili et al. 2010: 198-9).

Based on recent publications, three specimens can be identified as products of Lebanon, namely, one Beirut Type 3, one Type 8, and an Agora M334. The Beirut Types 3 and 8 were produced in Beirut, and the Agora M334 was likely produced in Jiyeh in the 6th century AD. The Beirut 3 and Agora M334 each represent 0.6% of the total MNI between the 1st BC – 4th AD, while the Beirut 8 base represents 0.4% of the total MNI from the 4th AD – 7th AD (Table 10.4). Again, these distributions are quite minimal, but the identification of a Jiyeh export is significant, as the type is notoriously difficult to differentiate in ceramic analyses (Wicenciak 2016a). This specimen confirms that Jiyeh products were indeed exported, whether directly from the site or through Beirut. No further statistical analysis was undertaken for these assemblages because the ceramic specialists have stated that the assessed sample is not holistically representative of the true assemblage (Hartal et al. 2016: 133; Silberstein et al. 2017).

7.2.1.8 Egypt

Beirut amphorae are also present at several sites in Egypt, though a detailed quantification of amphora finds is still lacking. Beirut Type 2 sherds have been uncovered in Marina el Alamein (Jakubiak 2016: 141, Fig. 14: H39, layer 4, M.12.009) and Alexandria (Wicenciak 2016a: 656), though none of the sherds appear to have been stamped. There is also evidence of Beirut Type 3 amphorae in Marina el Alamein and Berenike on the Red Sea (Daszewski et al. 1990: 47; Hayes 1996). Thus, during the 1st and 2nd centuries AD, it seems that several sites in Egypt were importing Beirut products packaged in the Beirut Type, though further study is needed to better understand ceramic frequencies and identify possible later forms (specifically Beirut Types 4-8, since 4-7 are often confused with Agora M334 amphorae and Beirut Type 8 has been mistakenly identified as an Egyptian form in some of the reports utilised in this thesis). In this thesis, sites in Egypt are assessed on the basis of presence/absence to explore the extent of regional distribution in the eastern Mediterranean.

7.2.2 Coastal Syria

7.2.2.1 Arwad Shipwrecks

The shipwrecks observed off the coast of Arwad (A, B, and possibly C) could also provide crucial insight regarding types of cargos being transported along the northern Levantine coast (Kampbell 2013). Preliminary examinations suggest Arwad A to be dated to the Hellenistic period, and Arwad B to the Late Roman or Byzantine period (Kampbell 2013: 420-1). Both wrecks appear to have been characterised by one primary amphora type (basket-handle amphorae for Arwad A and LRA1 for Arwad B), though other forms are also present (Kampbell 2013). Based on the published images, I have not identified any Beirut Type amphorae from the wrecks. Kampbell suggests the Beirut Type to be present in the Arwad B shipwreck (2013: 422, Fig. 5), but this is surely not the case. In the late Roman and Byzantine periods, the Beirut Type had a much thinner, straight-walled body with less rounded shoulders. The referenced specimen is likely an Agora M334 vessel, and the source could be from a number of places along the Levantine coast.

7.2.2.2 Ras el Bassit

Ras el Bassit, ancient Poseidium, is located on the northern Syrian coast on a north-facing cove, and served as an important maritime site throughout the Roman period. Recent excavations have focused on a church and two buildings in the nearby vicinity, all dated roughly to the 5th century AD with an abandonment in the early-7th century (Mills and Beaudry 2010). At the site, a number of amphorae were locally produced, mostly for regional distribution. They appear to have been continuously produced from the early Imperial period to late Antiquity (dates were established through a comparison with Ras el Bassit exports observed in Beirut) (Mills and Reynolds 2014). In addition to those forms attested in Beirut, Ras el Bassit transport containers were observed at the Fig Tree shipwreck in Cyprus (Leidwanger 2013a; Mills and Reynolds 2014).

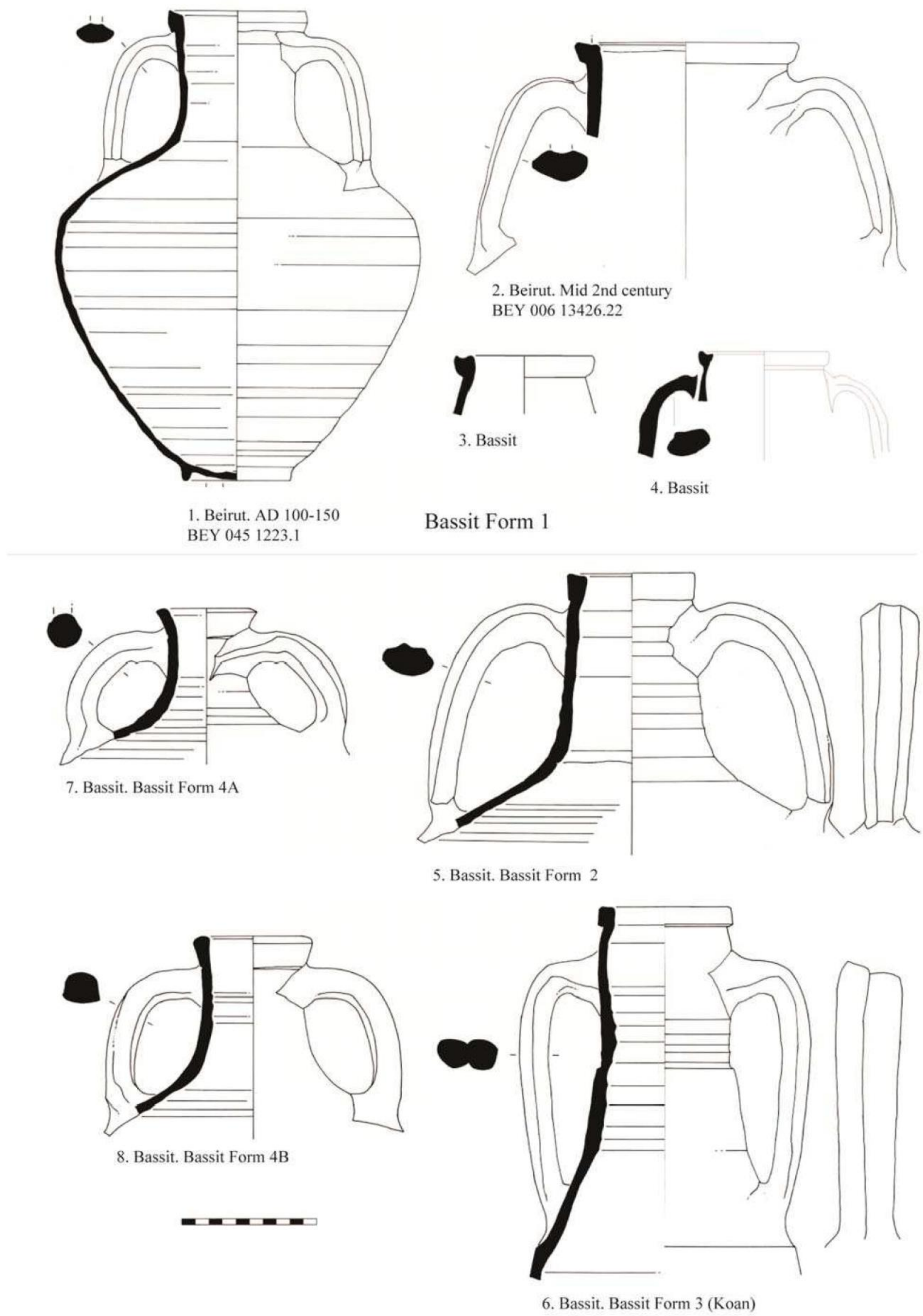

Figure 7.20: Early Imperial Ras el Bassit amphorae (top two were found in Beirut, the rest in Ras el Bassit) (after Mills and Reynolds 2014: 137, Fig. 3)

The ceramic specialists, one of which is credited with the development of the typology of the Beirut Type, did not observe any evidence of the Beirut Type. Therefore, we can surely say that the type is not present based on recent excavations, but the Imperial phases of the site are still not well-understood. Thus far, only LRA 1 from the early 5th century AD have been quantified in reports, though the typology of Ras el Bassit late antique amphorae has been outlined qualitatively (Mills and Beaudry 2010; Mills and Reynolds 2014).

7.2.2.3 Seleucia Pieria and Antioch

Founded near the end of the 4th century BC, Seleucia Pieria rose to become a key port site in the north-eastern part of the Mediterranean (Erol and Pirazzoli 1992: 320). In the Roman period, it was annexed and refurbished into a monumental port city (Pamir 2014). It seems to have served as an important military port given its key location close to the Orontes delta along a rare wide, flat plain along the Levantine coast (Sartre 2005: 260). It also was tied closely with Antioch as the maritime port for the wider hinterland (Keay 2012: 33). Antioch, located upstream along the Orontes, served as the capital of Roman Syria in the Imperial period (Millar 1993: 74). The city was massive, representing the largest urban space in the Roman Near East (Butcher 2003: 49). It had a river port along the Orontes, supplementing a dense hinterland (Butcher 2003: 12; Yener 2005: 40). The city's prevalence in the Roman period cannot be understated as a commercial centre; it was involved in the production and export of a variety of agricultural products and ceramics (Empereur and Picon 1989; Hayes 1991; Waliszewski 2014), had a coin mint (Millar 1993: 257) and remained the seat of the Syrian governor for centuries (Sartre 2005: 60).

Unfortunately, the main excavations of Antioch were undertaken in the early-20th century and ceramic analysis is fairly lacking (Reynolds 2010: 71, 146, Sartre 2005: 262). Specifically, common ware was not collected systematically, and typologies were not as developed as they are today. The site requires further work to establish a reliable typology and detail frequencies of specific types. Some preliminary examinations of the region have been undertaken, specifically regarding the production of LRA 1 amphorae (Empereur and Picon 1989), but a systematic and quantitative ceramic analysis of imports at Seleucia Pieria and Antioch has not yet been undertaken. Recent excavations may shed light on the commercial situation of the sites in the future (Pamir 2016), but the sites cannot dependably be incorporated into the database of this thesis at this time.

Through reviewing the Princeton photo archive of excavations at Antioch-on-the-Orontes, 32 amphorae were identified (Angarone et al. 2020). The primary type, composing 31.3% of the assemblage, is LRA 1, produced roughly in the 3rd AD – 7th AD (Figure 7.21). This corroborates the observations made by Empereur and Picon that the type might have been produced locally (in addition to a number of other locations) (1989: 237). The second dominant type is the Greco-Italic amphora (21.9%), imported roughly in the 1st century BC. 18.8% of the types were not identified, and one appears to be the Hayes II 'carrot' amphora observed at Paphos (Figure 7.22). Kaldeli has associated the Hayes II type with either the Beirut Type 2 or 3 (2013: 356), but the edged shoulder seems to differentiate it from the rounded, sloping shoulder of all Beirut Type amphorae. This is supported by the clear differentiation between the Hayes II type and the Beirut Type 3 in the drawings of Empereur (1987a: 42-3) and the Paphos typology of Hayes (1991). Rather, it can probably be sourced to Cyprus since it is the 2nd most common type observed in mid-2nd century AD destruction deposits at the House of Dionysus (Hayes 1991; Reynolds 2005: 569). It has been observed at Tripoli (Amadouny 1973: Pl. 7.T29), Salamis (Karageorghis 1967: Pl. 150.104), Kition (Reynolds 2005: 569), Amathous (Empereur 1987b: 26.4b) and possibly at Palmyra as well (personal communication with the Metropolitan Museum of Art and Princeton University Art Museum).

Figure 7.21: An LRA1 from Antioch (Angarone et al. 2020)

Figure 7.22: A Hayes II amphora, likely produced in Cyprus, found in Antioch (Angarone et al. 2020)

Recent surveys in the region have also not uncovered any Beirut Type amphorae, though the analyses can hardly be taken as representative of the area as a whole. The ceramics are largely out of context and have not been presented quantitatively, but rather, they have been used as preliminary dating material to better characterise the distribution of sites (Casana and Wilkonson 2005a; 2005b). This issue is further corroborated by the presence of several Beirut Type 8 sherds at Apamaea dated to the mid-7th century AD (Viviers and Vokaer 2008: 133), a site farther inland which lies close to the Orontes River. Presumably, if the amphorae were transported along the river, they would have had to pass through the region of Antioch.

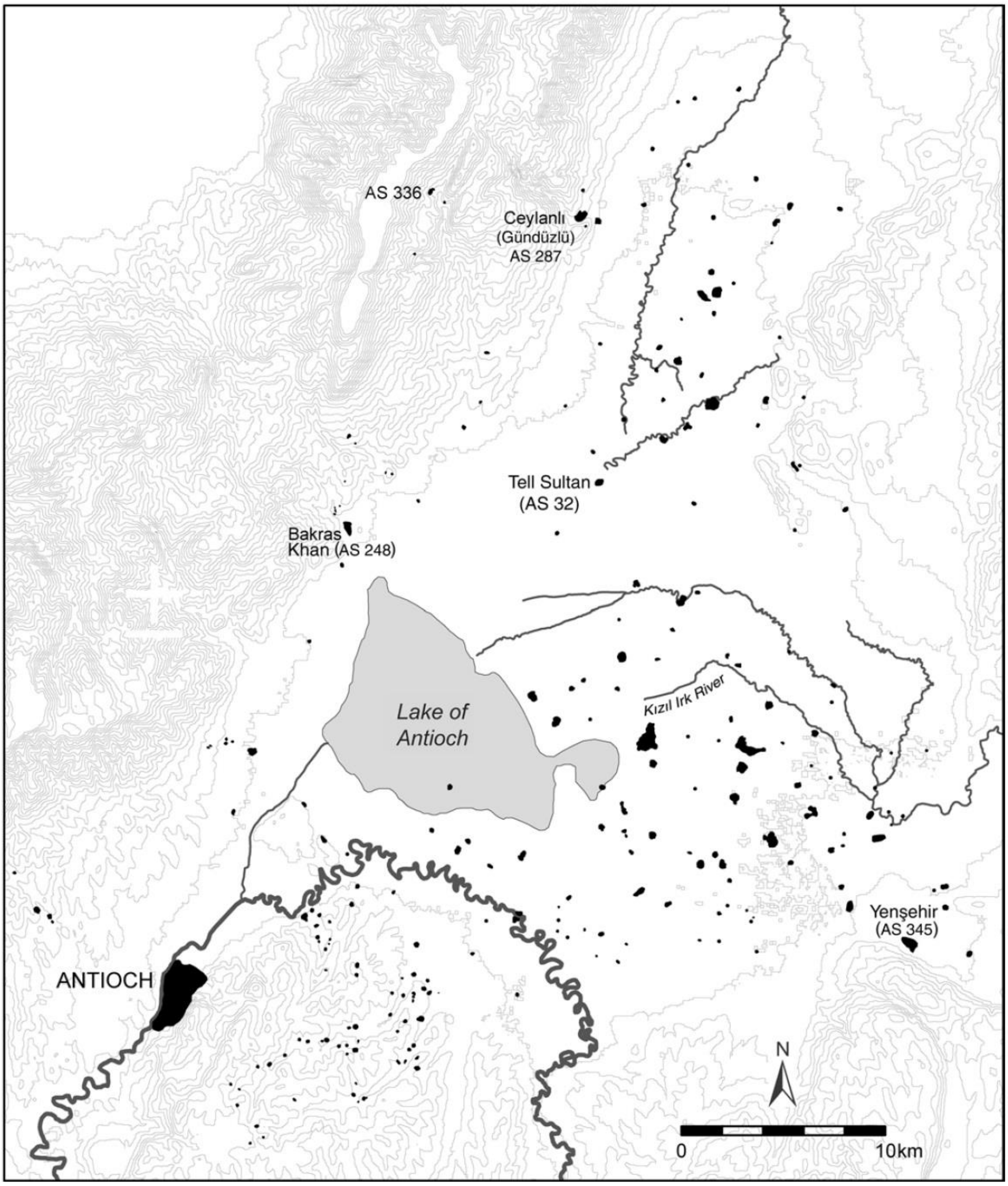

Figure 7.23: Distribution of Hellenistic, Roman and Byzantine sites in the region around Antioch (after Casana and Wilkinson 2005a: 60)

7.2.3 **Cyprus**

7.2.3.1 Paphos

Founded at the end of the 4th century BC, Paphos rose to become a major commercial and political centre in the eastern Mediterranean, especially under Ptolemaic rule. It remained the capital of the island under Roman rule, and was the seat of administrators and proconsuls of the island until the 4th century AD, when this role was assumed by Salamis (Kaldeli 2013b: 52).

Excavations have explored residential and commercial sectors of the city, with an assumed peak in economic expansion in the early Roman period based on rich, opulent villas and frequent public construction (Kaldeli 2013b: 52).

Three assemblages have been included in the ceramic analysis of Paphos for detailed quantification, specifically those from the Saranda Kolones Castle, the theatre in Paphos and the House of Orpheus (D.1.11). The House of Dionysus, excavated between 1962 and 1974, also provides valuable insight as to the ceramic patterns observed throughout the city, but has not resulted in a detailed quantitative study, likely due to the overwhelming quantity of ceramics uncovered (Hayes 1991: 2). Thus, some preliminary comments will be given regarding the quantities of Beirut Type amphorae observed, but the assemblages from the House of Dionysus will not be included in quantitative network analytical models.

At the House of Dionysus, a stamped Beirut 2 sherd was uncovered, along with a rim sherd from a Beirut 2 amphora and several other unspecified Beirut 2 fragments. From 2nd century AD contexts, six MNI of Beirut 3 amphorae were identified (three distinct rim sherds representing three MNI, a large body sherd and neck sherd representing one MNI and two unspecified specimens) (Hayes 1991: 92, Fig. 70.14-16). Thus, the type is attested within the assemblage from the House of Dionysus, a villa that can be characterised as fairly extravagant and wealthy.

Figure 7.24: A partial example of the Beirut Type 2 stamp found in Paphos (after Hayes 1991: PL XXIII.14)

At the Saranda Kolones Castle, the MNI is the more reliable figure for quantification, as acquiring a specific sherd count was difficult with the available report. The listing is often limited to 'fragments' or 'a number of pieces', giving the reader an indication of the vast quantity of material uncovered. As seen in Table 10.19, a wide range of vessels were observed, with no significantly dominant type. The largest percentage of types observed was characterised as miscellaneous Egyptian Byzantine amphorae at 18.5%. A Sidon 3 or Beirut 1 amphora was identified from among the assemblage, roughly dated to the late-2nd century BC – early-1st century AD, representing 1.2% of the total MNI. Two Beirut 2 amphorae were also observed, representing 2.5% of the total MNI. These percentages must be taken tentatively, because the assemblage includes a wide range of dates (Hellenistic to Late Byzantine). If the quantification was limited to types observed solely in the Hellenistic and Roman periods, the percentages would be roughly 4.3% and 8.7%, respectively.

At the theatre, two sherds of Beirut 3 and four sherds of Beirut 8 were observed, representing 0.8% and 0.9% of the total sherd count from each type's respective period. At the House of Orpheus, nine sherds of Beirut 3 were observed, representing 1.9% of the total sherd count (Kaldeli 2013b: Table 3.3.2.1.2). They are part of a diverse assemblage, with the highest quantity of finds being Dressel 2-4 amphorae (19.4%), Gaul 4 amphorae (10.9%) and local Hayes X amphorae (10.5%).

7.2.3.2 Kourion

Kourion was founded in the Late Bronze Age and continuously inhabited until the 4th century AD, when the city was completely devastated by an earthquake (Kaldeli 2013b: 59). It was occupied by Assyrians, Egyptians, Persians, Ptolemies and Romans, with a significant degree of commercial activity in the port city under Ptolemaic and Roman rule. After its destruction, the city was rebuilt in the 5th century AD, as attested by the late ceramics uncovered and the Byzantine churches (Kaldeli 2013b: 59).

At Kourion, analysis was more restricted in comparison to the well-explored sites of Amathous and Paphos. The material analysed is limited to that uncovered in the excavations recently undertaken by the Department of Antiquities, located at the Acropolis, which includes the Agora, the drainage system and certain other buildings (Kaldeli 2013b: 61). Unfortunately, it is difficult to link amphorae with specific contexts from each building due to the lack of publications. Thus, the assemblage can be utilised to shed light on patterns within the city as a whole. Although most of the material remains unpublished, some preliminary patterns are proposed that appear to corroborate other sites in Cyprus.

The assemblage is dominated by Dressel 2-4 imitations, probably produced locally, representing 28.3% of the total sherds (Table 10.14). What the examiner has called ‘Local Kourion I’ amphorae are next, representing 14.6% of the assemblage. Pamphilian and ‘pinched-handle’ amphorae represent the third most frequent types, at 8.7% each. Regarding types produced in Beirut, three sherds of Beirut 2 amphorae were uncovered, representing 0.9% of the assemblage, along with five Beirut 8 sherds, representing 1.4% of the assemblage. Two sherds from the ‘hole-mouthed’ amphora were identified, and characterised as a possible product of Lebanon. This type likely refers to a form of the ‘carrot-type’ amphora, some of which was produced in Beirut. It is probably dated to the late Hellenistic to early Roman period. In the excavations of the episcopal precinct, dated to the Byzantine period, one base of a Beirut 8 amphora was identified (Hayes 2007: 462, Fig. 14.5.E16), representing a similar frequency as the assemblage detailed in Table 10.14.

7.2.3.3 Amathous

Amathous is a city with a long history of habitation, dating back to the late Bronze Age (Kaldeli 2013b: 55). After a demise in its strategic and economic prevalence at the end of the Ptolemaic period, its port fell into decay starting in the early Roman period. The city was subsequently revitalised in the Antonine period, though it would never overtake Paphos or, in later periods, Salamis as the primary maritime centre on the island (Kaldeli 2013b: 55).

Two assemblages were assessed from Amathous from the Agora context and the Palaea Lemesos context (D.1.2). The Agora was excavated from 1976 to 1991, with most of the material remaining unpublished until Kaldeli’s examination in 2013. It dates to the period between 300 BC and the 4th century AD, but seems to have been continuously used as a centre of exchange roughly until the 7th century AD. It is situated around the centre of the city, and comprises a paved squared enclosed by porticos on three sides, with the shops located in the western part of the square (Kaldeli 2013b: 57-8). This context sheds light on amphora frequencies in a commercial context at the city.

Amathous Palaea Lemesos, situated on the slope of the acropolis at the lower part of the city, seems to be characterised by houses with simple architecture. Excavators have interpreted the houses to be largely ‘non-elite’, especially when compared to some of the Paphian villa which are better adorned and generally associated as elite villas (Kaldeli 2013b: 58). As the site covers the entire Roman period, cross-temporal comparisons can also be given. However, detailed publication of various quantities is still lacking.

As seen in Table 10.5 and Table 10.7, the Beirut Type has been observed at both sites. At the Agora, six Beirut Type 3 sherds and nine Beirut Type 8 sherds were uncovered representing 4% and 2.3% of the total sherds from their corresponding periods, respectively. In the Roman period of the Agora, these levels seem to be quite significant since there is no single dominant form (the highest observed type is Dressel 2-4 at 9%). At Palaea Lemesos, only one sherd of the Beirut Type 3 amphora was observed, representing 0.4% of the total assemblage. This assemblage seems to have been dominated by Dressel 2-4 imitations and Pamphilian amphorae, representing 30% and 15% of the total sherds, respectively. Based on this initial quantification, it seems that the Beirut Type is more frequently observed in a commercial context (marketplace) when compared to a residential area. Social class or the status of the inhabitants of each site seems to be a less associated factor, especially when one considers the presence of Beirut 3 sherds at the rural site of Panayia Ematousa in the hinterland of Kition (Winther Jacobsen 2005: 314). A possible AM 72 amphora from either North Lebanon or Beirut was also observed at Panayia Ematousa, further corroborating the idea (Winther Jacobsen 2005: 314, Fig. 166: A58.119). However, given the relatively low sherd count at each site, such propositions are still preliminary.

7.2.3.4 Salamis

Salamis is located on the easternmost part of the island, serving as the primary maritime centre in this region of Cyprus. Though it appears to have been a significant commercial and political centre throughout the Hellenistic and Roman periods, it rose in prominence primarily in the Byzantine period (Kaldeli 2013b: 62). In the beginning of the 4th century AD, the town was destroyed by several earthquakes, and subsequently rebuilt under the name of Constantia in the mid-4th century AD, and deemed the capital of the island. The city seems to have been abandoned in the 7th century after the Arab invasions (Maier and Karageorghis 1984: 249).

The amphora assemblage assessed from Salamis can hardly be taken as a statistically significant sample since the 75 MNI were selectively included in the report. Regardless, the report has been analysed to give some preliminary observations (D.1.12). The observed types date from the Hellenistic period to the Byzantine period, when Salamis became an important economic centre in the eastern Mediterranean (Karageorghis 1999: 16).

Figure 7.25: Three examples of the Beirut Type 8 amphora found in Salamis, Cyprus (after Diederichs 1980: 96, PL. XX.207-210)

Unsurprisingly, the majority of the assemblage dates to the late Roman and Byzantine periods. Three Beirut Type 8.2 amphorae were observed from within the assemblage (Diederichs 1980: Pl. 20.207-10), representing 4% of the total MNI of amphorae from the city in the ceramic report. Based on a review of published photographs and drawings from the ceramic report, no earlier Beirut Types were observed. It is tempting to tie this to the economic development of the city in the Byzantine period when it was designated as the capital of the island in the 4th century AD (Maier and Karageorghis 1984: 249), but the fragmentary state of publications at this time makes such a definitive statement difficult.

7.3 General Trends and Commercial Patterns

Based on the assessed data, two main peaks in both the extent as well as the capacity of distribution of the Beirut Type can be specified: the first peak spanning the dates of Types 2 and 3 (early-1st to mid-2nd centuries AD), and the second peak coinciding with the Type 8 production period (second half of 5th to mid-7th centuries AD). From the late-2nd century BC till the early-1st century AD, the Beirut Type 1 amphora is found primarily in Beirut itself. It has appeared at Paphos and Yavneh-Yam, but in low quantities and based on preliminary identifications. This would suggest that the Beirut Type 1 amphora was not distributed in any significant capacity outside the city. Within Beirut, it represents the majority of the amphora assemblage.

The Beirut Type 2 amphora is observed much more extensively than its predecessor. Along the Levantine coast, it has been noted at Beirut, Khalde, Jiyeh and Sidon, and farther inland at Chhîm and Tel Anafa. In Cyprus, Beirut Type 2 amphorae have been seen at Kition, Amathous and Paphos, where a stamped sherd was uncovered. Though the range of exports is wider than that of the Beirut 1 amphora, the quantities observed are quite low. Outside of the production centres, where it makes up between 45% and 65% of the total assemblage, it consistently represents less than 5% of the quantified assemblages in the regional market. Outside of the Levant and Cyprus, it has been observed at Berenike in Libya, Marina el-Alamein and Alexandria in Egypt, and Athens in Greece. As in the case of sites along the Levantine coast and at Cyprus, this seems to have been limited to several sherds in each region.

Type 3 also seems to have been distributed quite widely, even reaching as far as Britain (Figure 6.28). It has been noted in slightly higher quantities in comparison to Type 2, though the sole production centre for this form is in Beirut. The type has been observed at several sites to the south, including the residential quarters at Jiyeh, as well as Amathous, Paphos and Panayia Ematousa in Cyprus. Based on the data presented, it cannot be stated that distribution is focused on any specific region, as it appears Beirut Type 3 is observed uniformly in the southern Levant and Cyprus, and the state of research in the northern Levant does not permit definitive conclusions. Two main points must be highlighted regarding the Type 3 distribution: firstly, that the type seems to be distributed to the widest range of sites, and secondly, that the quantities and proportions of total assemblages is the highest among all periods. The Type 3 amphora was distributed to 12 ports (excluding terrestrial sites and Beirut), higher than the seven recipients observed for the Type 2 amphora (excluding Beirut, Jiyeh, and Khalde which were production centres as opposed to importers, and also excluding the terrestrial sites of Tel Anafa and Chhîm). Based on this data, it appears that the Beirut Type's distribution reached its peak in both scope and scale between the first half of the 1st century AD and the mid-2nd century AD (Types 2 and 3). Furthermore, though a more in-depth examination of sites beyond the Levantine coast and Cyprus is needed to better understand the wider distribution, there is evidence that the Beirut Type reached the western Mediterranean and beyond.

Finally, another interesting point to note is the fact that only Paphos and Marina el-Alamein imported both Beirut Types 2 and 3. In all other cases, sites only imported one or the other. This discontinuity may be reflective of changing distributive patterns in the transportation of *Berytus* wine and oil (examined in more detail in the next chapter). This change also occurs during a shift in the location of Beirut Type kilns (in Beirut, Jiyeh and Khalde for Beirut Type 2, but only in Beirut for Beirut Type 3), but it is unclear if the two patterns are related.

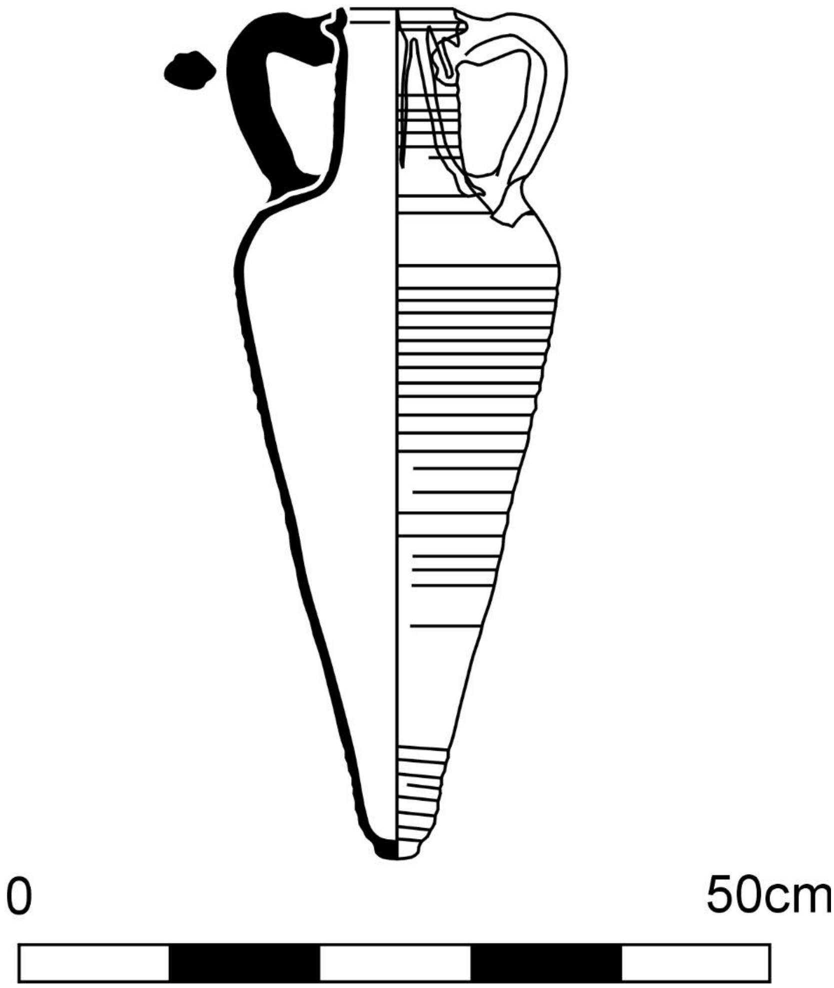

Figure 7.26: An Agora M334 amphora, which strongly resembles Beirut Types 5-7 in the handles, which are arched in profile and oval with centrally located flat bands with two grooves in the section (after Keay and Williams 2014)

There is a sharp drop in the Beirut Type's distribution from the end of the 2nd century AD to the mid-3rd century AD as observed in the quantities of the Type 4 amphorae throughout the eastern Mediterranean. Outside of Beirut itself, no recorded examples were identified at any sampled site. After a break in production till the till the mid-4th century AD, this minimal distribution continues till at least the second half of the 5th century AD, when the Beirut Type 8 comes into production and is observed throughout the eastern Mediterranean at eight sites (excluding Beirut). As the focus of this thesis is on the period between the 2nd century BC and 3rd century AD, I will not be assessing the distributive patterns of Types 5-8 in detail. However, it must be stated that the maps depicted above may not be representative of the true percentages of Beirut

Type amphorae in each assemblage. This is due to the possibility of incorrect identifications of Beirut Type amphorae as Agora M334 amphorae due to morphological similarities (Figure 7.26). Unfortunately, it is quite difficult differentiating the types based on ceramic reports without detailed ware analysis, more complete specimens, or photographs.

7.4 Conclusion

Ultimately, the Beirut Type does not appear to have been distributed in any significant volume, though it is observed at a wide range of sites. Preliminary examination suggests that Cyprus might have been particularly targeted (7.2.3) (Reynolds 1999: 61), especially in Beirut Type 2 containers from the early-1st to early-2nd centuries AD. The Type 3 seems to be more evenly distributed, observed periodically along the Levantine coast and at a wider range of sites throughout the Mediterranean. However, these general patterns require contextualisation and cross comparison with other commercial trends observed at each port city.

Chapter 8 Analysis of the Amphora Distributions

Most importantly, [networks] can cross scales. Anything from a household to the state can be thought of in terms of a network.

-Knappett 2013: 7

As Knappett states, the organisation of data into networks allows for multi-scalar analysis, which can be extremely useful for archaeologists. Regarding economic patterns in the Roman Empire, this point is crucial, since macro-economic trends across the Empire might not be correlated with commercial fluctuations at a single port town. How, then, is the best way to organise the data into various scalar foci? Furthermore, what is the most appropriate way to assess these networks quantitatively? In addressing these questions, I have chosen to contextualise the presence/absence and frequency data with various independent variables such as spatial distance and environmental patterns. As discussed in Chapter 4, this allows for a comparison between spatial closeness with commercial closeness to see if geographical distance is an explanatory variable in *Berytus*'s maritime distribution networks (8.1.1.1). This is complemented by a consideration of the commercial centrality of each site (8.1.1.2), followed by a discussion of wider networks based on other ceramic trends and the degree of reciprocity with Beirut (8.1.2 and 8.2).

8.1 SNA and Complex Systems in Roman Beirut

Based on the data presented in the previous chapter, the Beirut Type does not appear to have composed a significant percentage of any port assemblage. However, the data can still be quite revealing in shedding light on commercial routes and causative factors in these distributions through network analysis. Furthermore, low-frequency distributions are revealing in themselves in shedding light on the way in which these products might have been transported, and help contextualise socio-political developments at this time. Thus, I now turn to quantitative and statistical analysis to explore intra-regional connections based on two key principles outlined in section 2.2: centrality and small-world networks.

The centrality measure is quantified here through two forms of regression analysis. The first uses geographical spacing as the independent variable (x-axis) with the frequency of the Beirut Type as the dependant variable (y-axis) to test the relevance of distance in the Beirut Type's distribution (closeness). The second uses statistical indices (mean, median, standard deviation and range) of amphora assemblages at each port site as the independent variables (x-axis) with the Beirut Type frequency as the dependent variable (y-axis). This essentially tests whether the composition of an assemblage (either heterogeneous and varied with a wide range of sources and no dominant type, or more homogeneous and dominated by one or two sources and with a low frequency of imports) is correlated to the distribution of the Beirut Type (degree).

The statistical tests for this section were all conducted in Microsoft Excel using the Correlation function and Regression function from the Data Analysis tool, and the Logistic Regression tool from XLSTAT. A **correlation** measures the relationship between two variables (Gravetter and Wallnau 2005: 461), in this case the frequency of an imported amphora with the frequency of the Beirut Type. The resulting value details the direction of the relationship (positively correlated or negatively correlated), the form of the connection (linear vs non-linear), and the strength of this connection (a correlation value of 1.00 or -1.00 indicates a perfect consistency, while 0 indicates no relationship at all) (DeMaris 2004: 26; Gravetter and Wallnau 2005: 461). A **regression** is an equation that describes a relationship between independent and dependent variables, characterised by a linear function (DeMaris 2004: 2-3; Gravetter and Wallnau 2005: 452-4). The difference between strict correlation and regression analysis is that correlation measures a binary relationship between two variables, while a regression can utilise multiple variables within a single equation (Cohen 1988: 76). In other words, regression analysis tries to find the best-fit function that describes a dataset, and attempts to predict unknown data based on this relationship. I have differentiated between each method in this thesis because correlation coefficients compare one dependent and one independent variable, which is effective for assessing the degree of correlation between the amphora frequencies from two sources. Regressions, while they perform a similar function, allow for the incorporation of multiple independent variables, and also allow for predictive modelling (DeMaris 2004: 2-3).

These methods allow a null hypothesis to be tested by calculating the relationship between the independent and dependent variables based on varying degrees of reliability and probability. The **null hypothesis** is essentially a proposition that there is no relationship between the independent and dependent variables, and that any changes in the independent variables will have no statistically significant effect on the dependent variable (Cohen 1988: 1-4; Gravetter and Wallnau 2005: 192). The goal of the statistical tests in this chapter is either to accept or reject the null hypothesis with a degree of certainty, and be able to make definitive statements about maritime commercial patterns within which Roman Beirut was involved. This certainty is measured by the **p-value**, which provides a confidence interval that our conclusion is correct. The most common p-values utilised are generally 0.01, 0.05, and 0.10 (99%, 95%, and 90% confidence in the conclusion regarding the null hypothesis) (Hanvey 2018: 156).

In regression analysis, the **R Squared** value determines the closeness of fit of the proposed linear regression with the actual data. This value will range between 0 and 1, with a value closer to 0 indicating a poor fit and a value closer to 1 indicating a good fit. The statistical significance of this relationship is provided by the **Significance F** output in excel, which is a measurement that compares a model that omits the independent variables with a model that includes them (Archdeacon 1994: 192). A low Significance F value, for example .05, indicates the probability that all the independent variables actually have no effect on the dependent variable (0.05 means that 5 times out of 100, the model's independent variables have 0 effect on the dependent variable). Thus, a low Significance F value is necessary to dependably reject the null hypothesis that the independent variables do not have any effect on the dependent variable (Henkel 1976: 43-4), and accept the alternative hypothesis that there indeed is some relationship.

Finally, it is necessary to clarify again that the analysis conducted in this chapter should not be taken as an overestimation of the significance of the Beirut Type's distribution, as it represents less than 5% of all sampled assemblages outside production centres. Thus, clearly distribution was quite limited in scale, though the scope/range was fairly extensive. To combat this dearth in the data, I have prioritised statistically significant connections (90% or 95% confidence).

8.1.1 **Centrality**

8.1.1.1 Closeness

Due to the limitations of the data analysed in this thesis, I have simplified the centrality measure here by differentiating solely between closeness and degree. Typically, to examine closeness in analyses of ceramic distributions, geographical distance is usually utilised as the independent variable, with the assumption that as distance increases, distributions drop (Kaldeli 2013a; 2013b: 205; Parker 2008: 179-82; Renfrew 1977: 72; Reynolds 2010; Tomber 1993). However, recent research has shown that with a GIS-based approach, several factors can be incorporated to allow for much more accurate results (Abou Diwan and Doumit 2017; Leidwanger 2013c; Safadi 2016; Safadi and Sturt 2019). With regards to maritime commerce, such factors include wind speed and directionality, currents, visual guides, transit anchorages, and numerous other considerations relevant to the ancient merchant (Blue 1995: Chapter 6; Casson 1995: 270-7; McGrail 2009; Morton 2001: 19-26, 223, 243). These can all be assessed in a way to consider maritime routes based on sailing time as opposed to strict geographical distance.

Although the data utilised in testing these considerations is quite sparse (Chapter 7), a regression utilising geographical distance as the independent variable and the distribution (presence/absence and frequency) of the Beirut Type as the dependent variable corroborates the abovementioned propositions (Appendix E). Namely, the null hypothesis, which is that geographical distance is unrelated to the distribution of the Beirut Type, can be sustained since the R Squared value is a poor fit in every regression, and Significance F and P-values indicate a lack of statistical reliability. In the logistic regressions for presence/absence data, similar results were acquired, with the null hypothesis sustained (E.2.1, E.3.1, and E.4.1).

Rather, the prevalent routes suggested by wind speed and directionality, as well as current systems in the eastern Mediterranean, might be more revealing in correlating spatial closeness with commercial closeness. For example, there appears to be a concentration in the distribution of Beirut Type 2 amphorae in Cyprus and an absence at closer sites in the southern Levant. As discussed in Chapter 3, sailing from Beirut to Cyprus would have been undertaken under optimal conditions on Spring mornings and anytime in Winter. The same journey would have been undertaken upwind or close-hauled anytime in Summer and Autumn, and on Spring afternoons (Safadi 2018: Chapter 6). This might have made Cyprus an attractive destination point specifically from Beirut throughout the year, as has been suggested in the past (Arnaud 2004: 3-4). Similarly, travelling from Cyprus to Beirut was facilitated by wind patterns in Autumn, on Spring afternoons, and in Summer.

Conversely, travelling south from Beirut is quite difficult throughout the year, with favourable wind conditions aiding the journey only on Spring mornings (3.2.1). However, generally, upon reaching Tyre, continuing south was quite difficult (Safadi 2016: 354-5). Rather, sailing north along the Levantine coast is much easier throughout the year. Thus, perhaps the sporadic but evenly-spaced distribution of the Beirut Type 3 amphora represents various legs in the journey south due to adverse conditions. Indeed, if the estimate of Whitewright of 1.9 knots is accurate regarding a journey in unfavourable conditions (Whitewright 2007: 85), the journey to Akko and Caesarea would have required close to two days (roughly 41 hours and 55 hours, respectively), while the more southern sites of Jaffa and Ashkelon would have required closer to 3 or 4 days (76 hours and 91 hours, respectively). Of course, these propositions are just preliminary and based primarily on the distribution of the Beirut Type 3 amphora and the estimates provided by Casson and Whitewright; future work might shed further light on this examination through a closer look at seasonal and daily fluctuations, especially with regards to harbour accessibility to prioritise sailing time over geographical distance (Leidwanger 2013c; Safadi 2016; Safadi and Sturt 2019). Furthermore, the environmental patterns discussed in this section and in 3.2.1 indicate that sailing north from Beirut seems to be aided by winds and currents throughout the year, apart from Spring mornings. Thus, perhaps the lack of distribution of the Beirut Types 2 and 3 in the northern Levant is due to the current state of research as opposed to a true absence. Regardless, the spatial closeness between Beirut and Cyprus (3.2.1) might be correlated with their commercial closeness, which is corroborated by the distribution of Beirut Type 2 amphorae.

Type 8 is also distributed fairly evenly in terms of the spatial variation, but is absent at distant sites in the southern Levant. However, it must be recalled that it has also been observed in Turkey at wrecks off the coast of Bodrum (Reynolds 1999b: 391; 2013: 103) and the wreck at Iskandil Burnu (Lloyd 1984: 32), and quite frequently at Apamaea in Syria (Viviers and Vokaer 2008: 133). While it is tempting to suggest a shift in focus to the north-eastern Mediterranean and Cyprus in later periods, the data is too sporadic to arrive at any definitive conclusions. However, socio-political developments in the Late Roman Empire, specifically the decline of the Western Roman Empire and the movement of the capital to Constantinople, might have played a part in the changing maritime networks within which Beirut was involved.

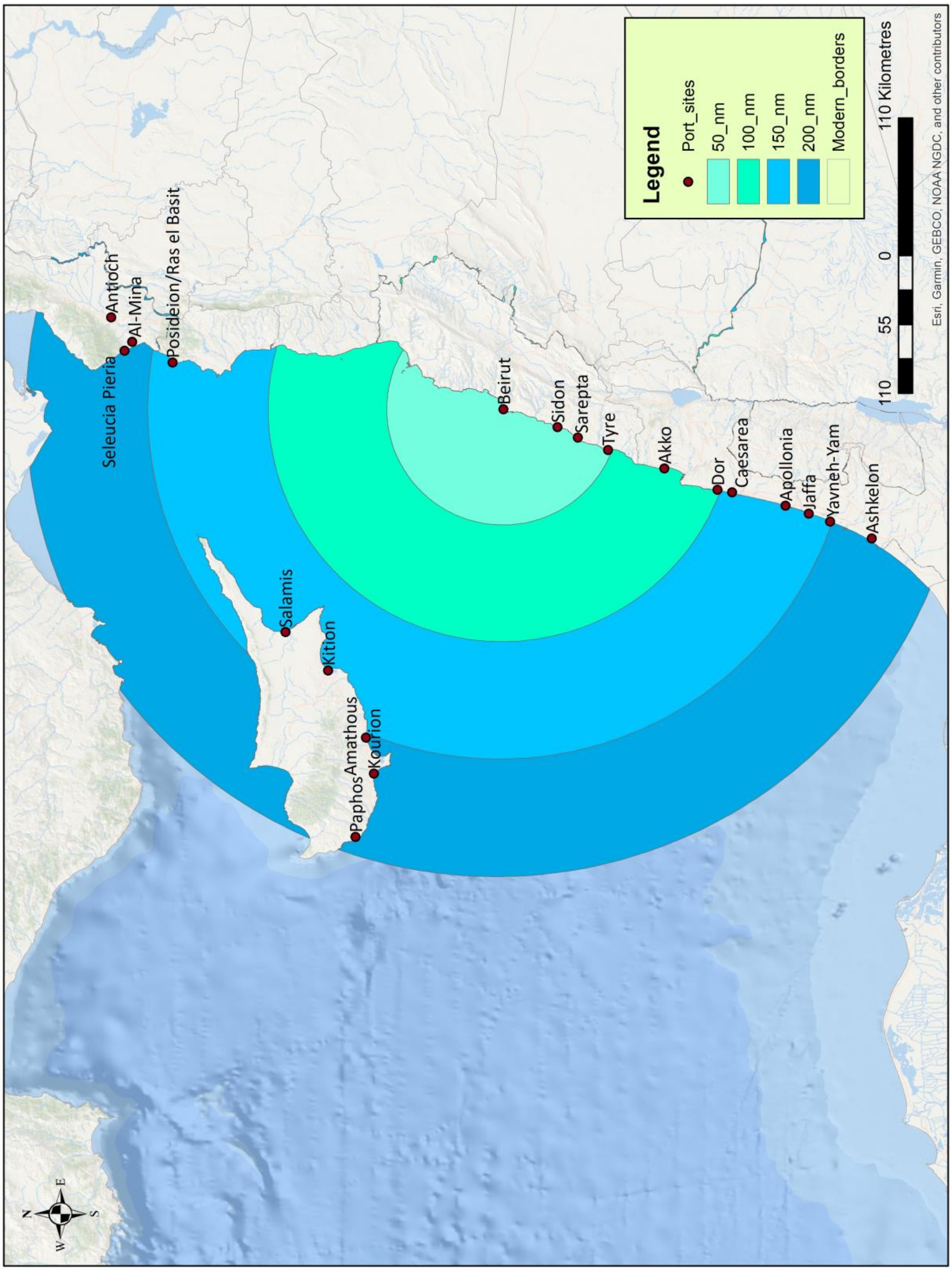

Figure 8.1: The sampled port sites assessed based on their geographical distance from Beirut in 50 NM intervals

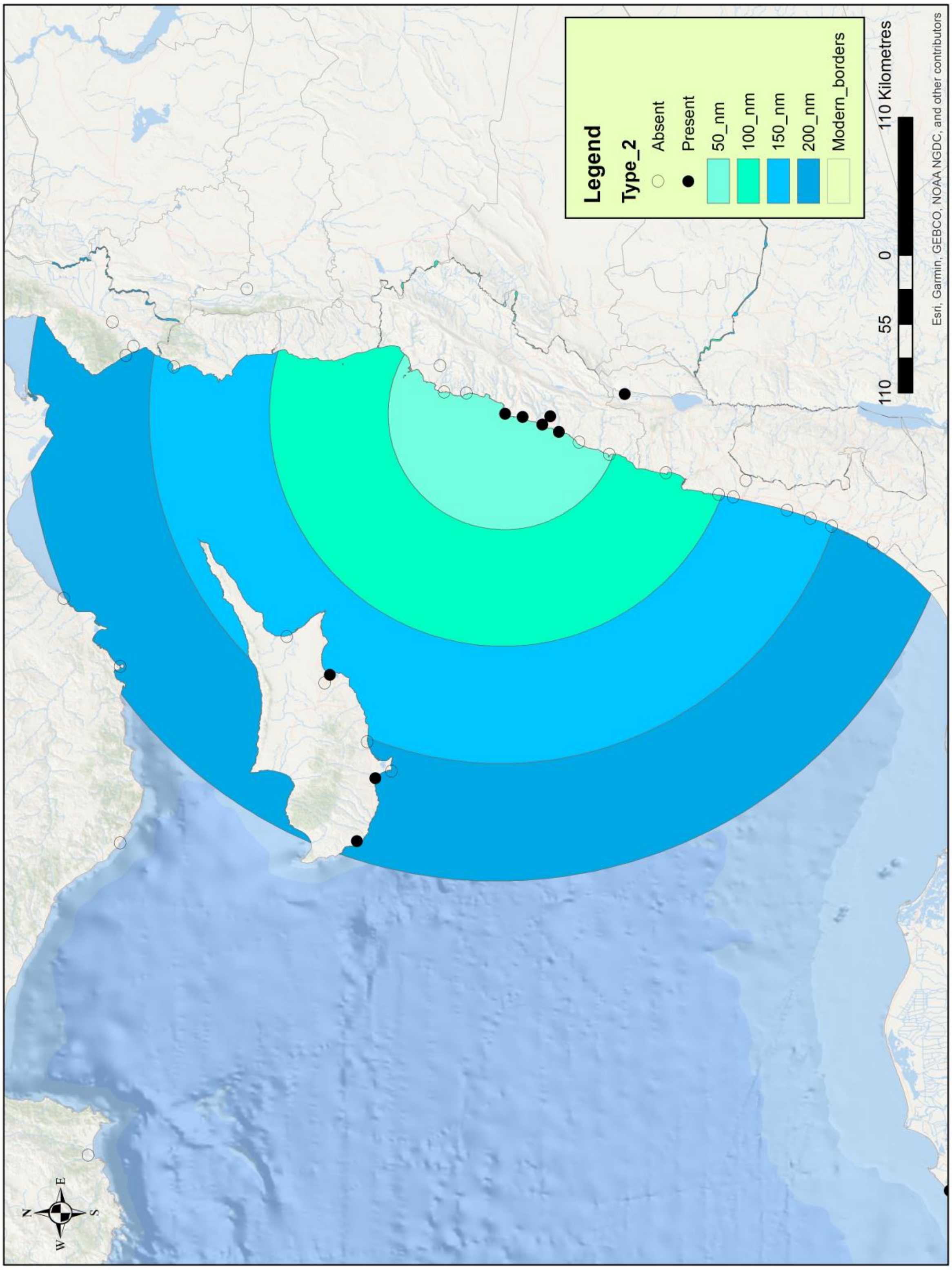

Figure 8.2: The distribution of Beirut Type 2 amphorae organised by spatial divisions of 50 NM

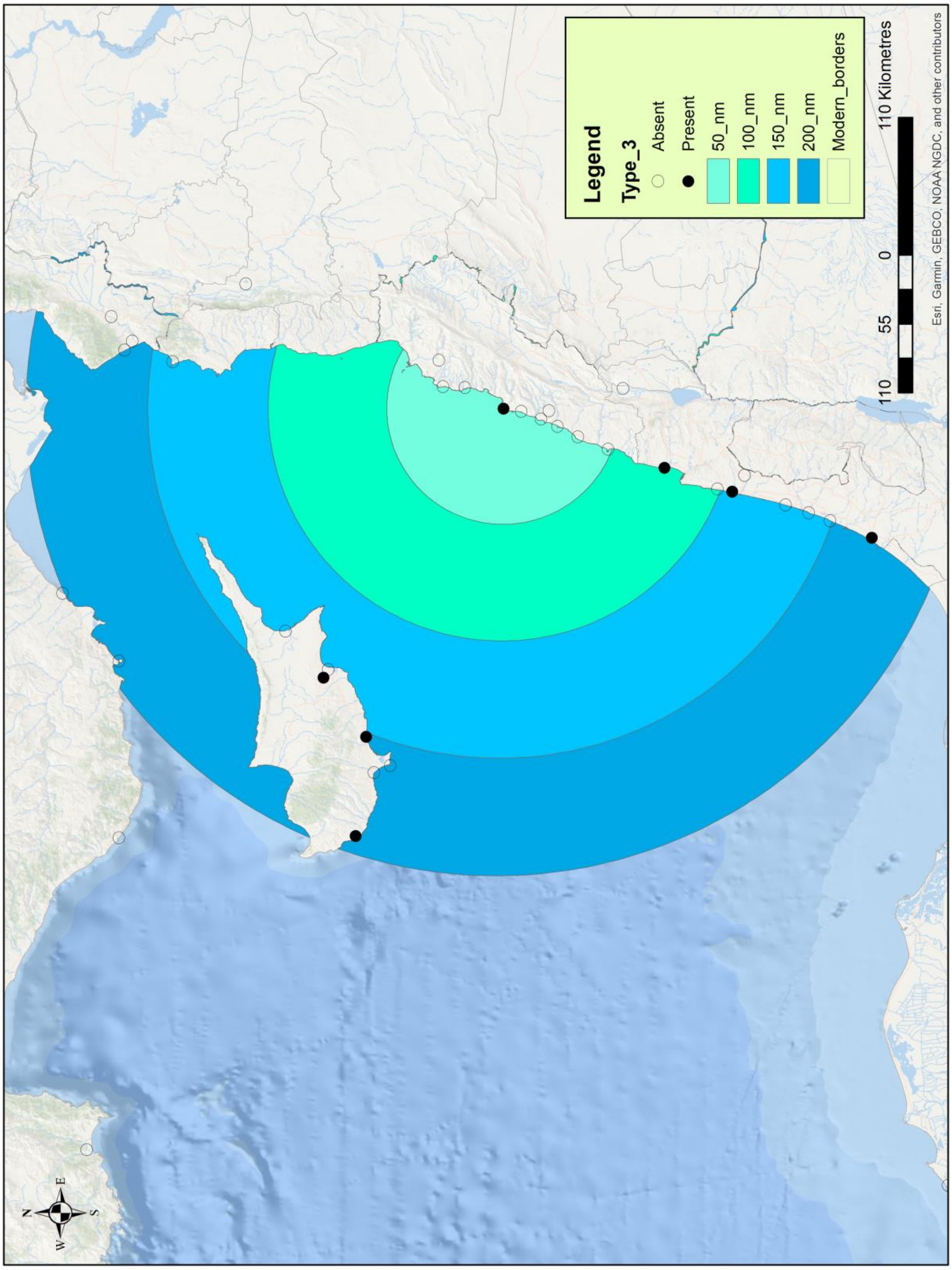

Figure 8.3: The distribution of the Beirut Type 3 amphorae based on geographical spacings of 50 NM

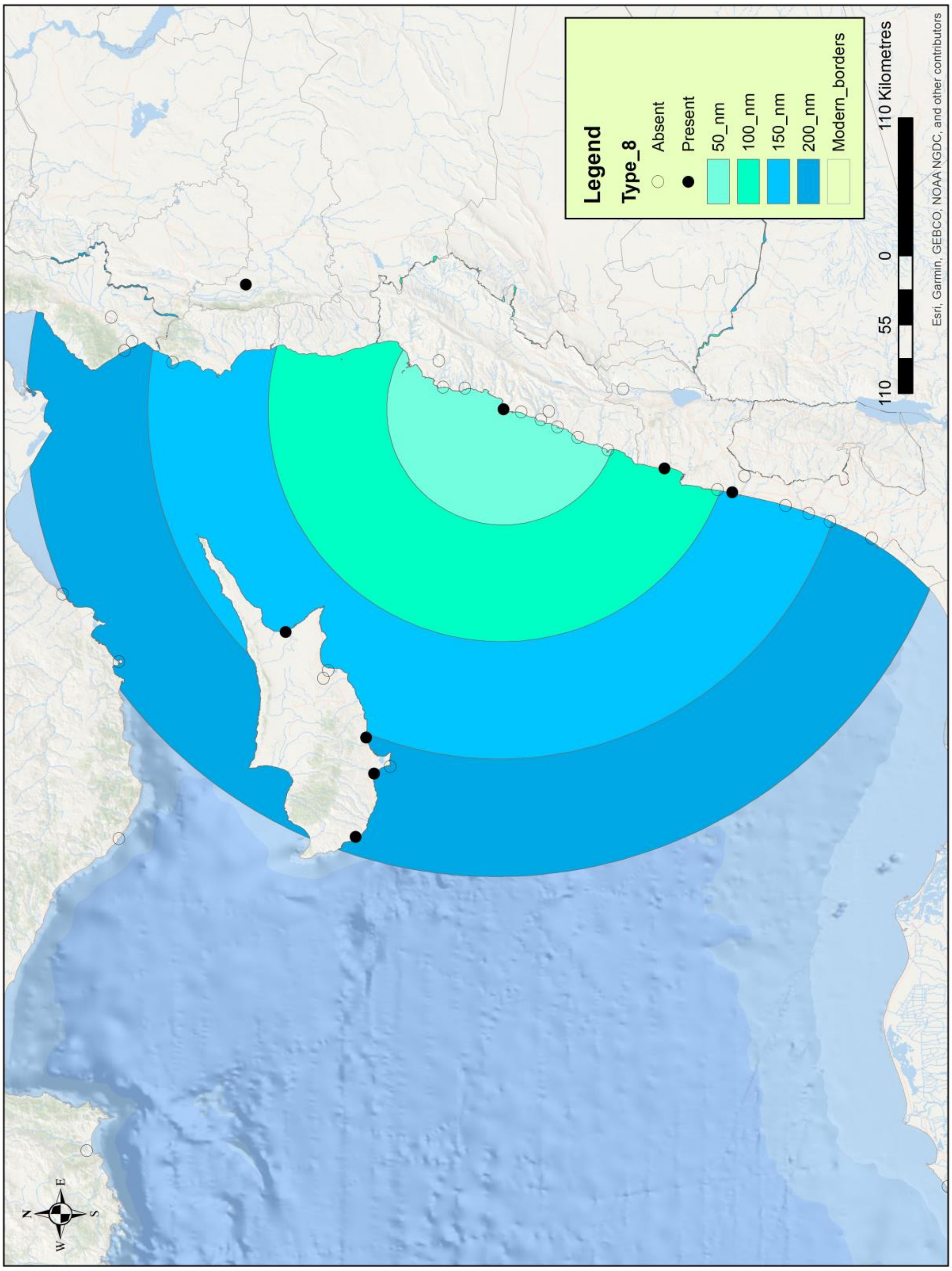

Figure 8.4: The distribution of the Beirut Type 8 amphorae based on geographical spacings of 50 NM

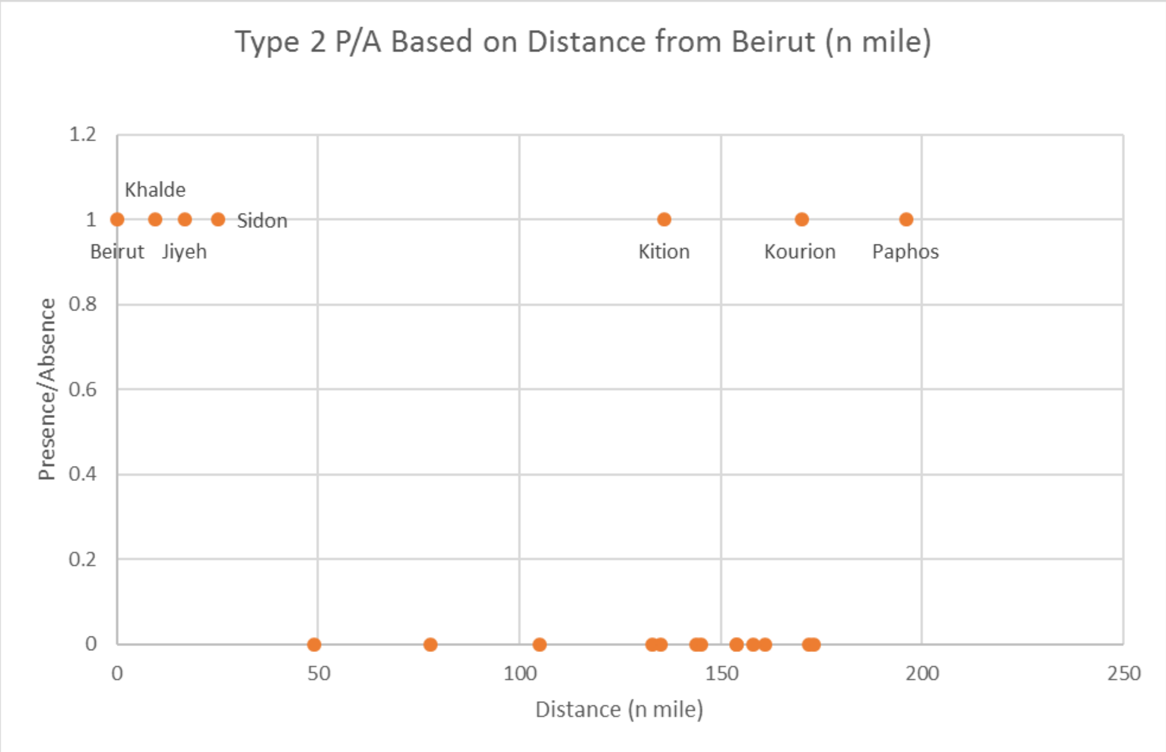

Figure 8.5: Scatterplot of sites where the Type 2 amphora was found based on presence/absence

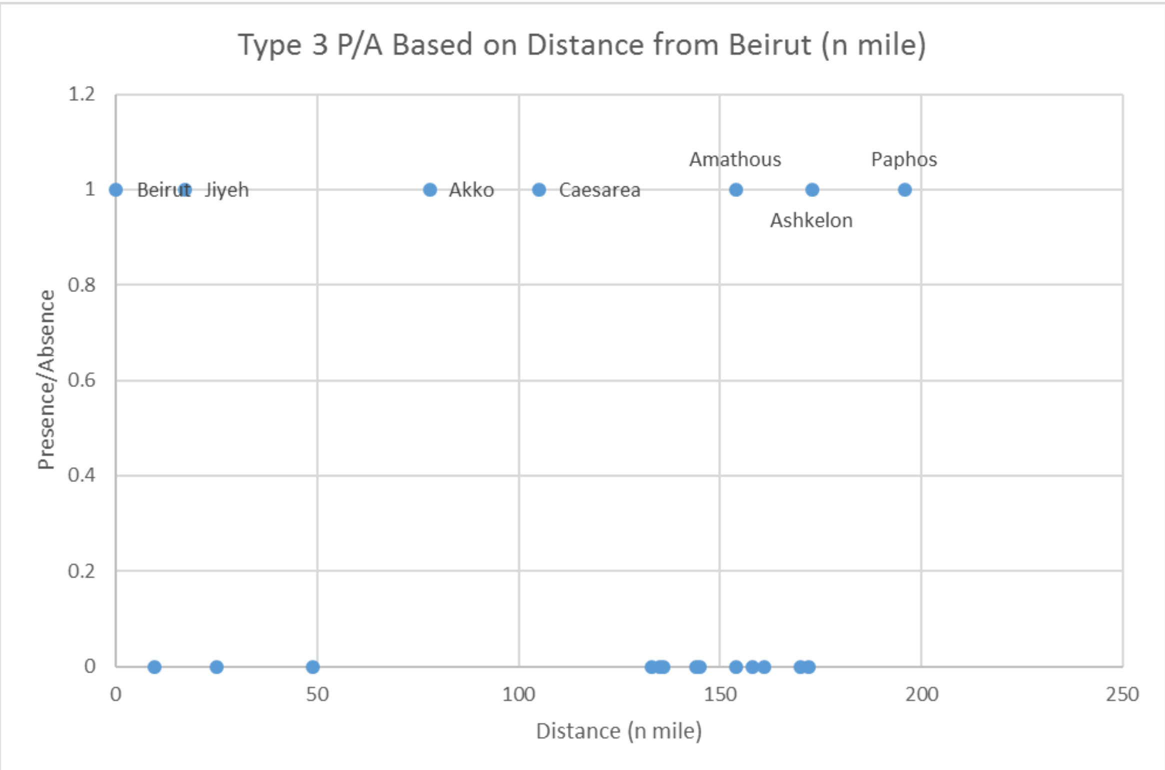

Figure 8.6: Scatterplot of sites where the Type 3 amphora was found based on presence/absence

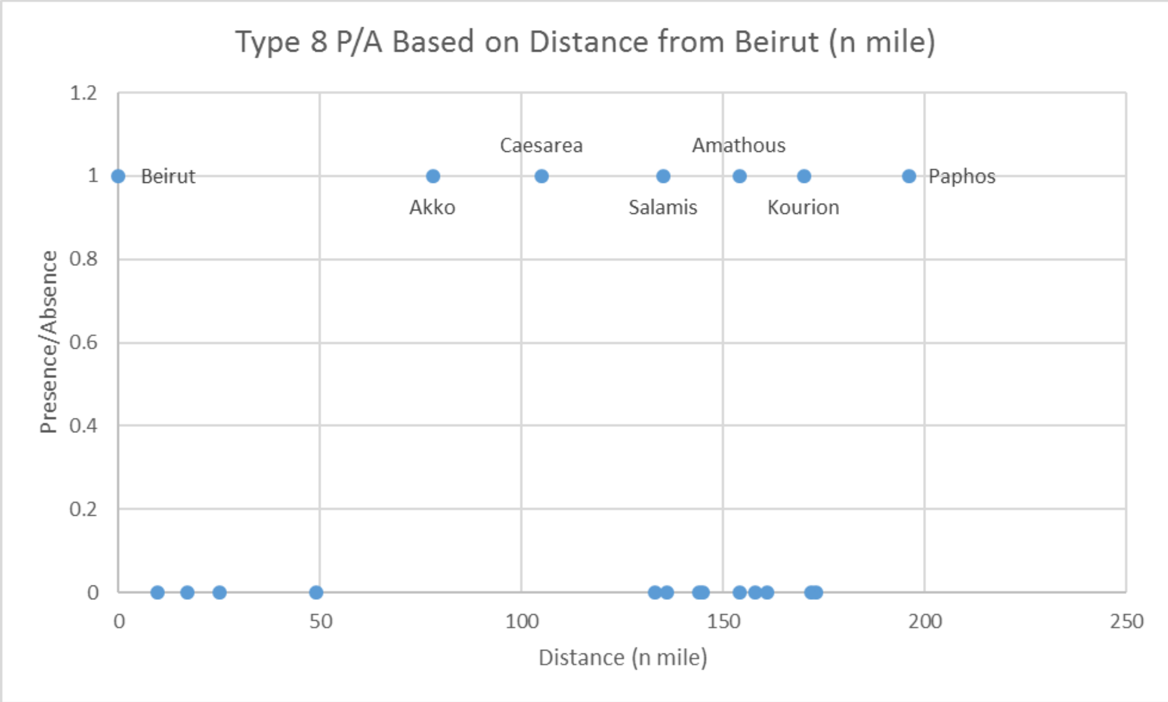

Figure 8.7: Scatterplot of sites where the Type 8 amphora was found based on presence/absence

8.1.1.2 Degree Centrality

Additionally, other incentives might have driven merchants in transporting Beirut Type amphorae from Beirut to the surrounding region. One of these incentives might be related to the level of connectedness of a port site, making it a more attractive target for the potential sale of a ship's cargo, or the purchase of additional cargo along one's journey. As Arnaud argues, a port's commercial centrality can be understood as a form of incentive for traders, a stimulus to acquire a valuable cargo on their journey based on the assumption that a well-connected port provides a variety of goods from different origins and, consequently, greater choice for the merchant (Arnaud 2016: 132). In this thesis, degree centrality is determined first by calculating frequencies of imports from various sources, followed by the mean, median, range and standard deviation of said frequencies of types observed at each port site. These measures give the following information regarding each amphora assemblage, all based on the source of the amphora:

- Mean – The average represented percentage of amphora types
- Median – The midpoint of the frequencies of amphorae in an assemblage
- Range – The difference between the percentages of the least and most frequently-observed amphorae
- Standard deviation – A measure of the level of average deviation between amphora frequencies

These statistical indices shed light on the composition of each assemblage by measuring the variance in import frequencies. This is done in order to differentiate between a port site that may have been primarily importing from a single source (or characterised by primarily local production) from a site importing from a heterogeneous set of sources. Subsequently, the frequency of the Beirut Type is compared to these factors to determine if there is any degree of correlation. In this way, the degree centrality moves beyond the *number* of connections (scope) and the *strength* of these connections (scale) by providing the first inquiry into how merchants were choosing the recipients of *Berytus* products. Because this analysis requires fully quantified assemblages, I have only included the sites of Amathous, Apollonia, Ashkelon, Caesarea, Kourion, and Paphos in regression and correlation analysis in the following sections as reflective samples for the southern Levant and Cyprus. Again, this leaves a dearth in the northern Levant that hopefully can be supplemented as the state of research improves.

8.1.1.2.1 Results

Based on the results presented in Appendix F and Appendix G, regression analysis using the average, median, standard deviation and range as independent variables and the frequency of the Beirut Type as the dependent variable indicate the following statistical conclusions:

- The R squared value of the Type 2 regression is 0.20, indicating a poor fit of the data with a possible model utilising the statistical indices mentioned above as independent variables. Furthermore, Significance F and P-values for all independent variables are high, further indicating that the null hypothesis must be accepted that **there is no statistical relationship between the composition of amphora assemblages at port sites with the frequency of Type 2 distributions**.
- The R squared value of the Type 3 regression is 0.22, indicating a poor fit of the data with a possible model utilising the statistical indices mentioned above as independent variables. Furthermore, Significance F and P-values for all independent variables are high, further indicating that the null hypothesis must be accepted that **there is no statistical relationship between the composition of amphora assemblages at port sites with the frequency of Type 3 distributions**.
- The R squared value of the Type 8 regression is 0.26, indicating a poor fit of the data with a possible model utilising the statistical indices mentioned above as independent variables. The Significance F value is high, indicating that all independent variables taken together are poor predictors for the dependent variable (Beirut Type 8 frequency). The p-values of mean, median and standard deviation are high (0.753, 0.693, and 0.297, respectively), but that of range is 0.136, indicating that **there is no statistical relationship**

between mean, median and standard deviation of the frequency of imports of amphora assemblages and the Beirut Type 8 distribution, but there is a relatively significant (86.4% confidence) relationship between range and the Type 8 distribution with a coefficient of .065.

8.1.1.2.2 Interpretation

Based on the regressions undertaken, earlier types do not appear to have been distributed in any distinct pattern related to the types of amphora assemblages observed at port sites in the southern Levant or Cyprus. In other words, merchants transporting *Berytus* products were not more likely to target well-connected port sites. At Amathous for example, Beirut Type 3 sherds were found in the context from Palaea Lemesos, which is dominated by local types. Conversely, the more heterogeneous Agora assemblage (more well-connected in that it was importing vessels from a number of sources throughout the Mediterranean) also included a limited amount of Beirut 3 amphorae. Similarly, Type 3 was identified in Kourion's assemblage of earlier types, which is dominated by local sources, as well as at the heterogeneous assemblage at the House of Orpheus at Paphos. This indicates that in the Imperial period, merchants transporting the Beirut Type in the eastern Mediterranean did not prioritise well-connected port sites as primary targets. Rather, the lack of correlation suggests that perhaps they were a supplementary cargo en route to another destination.

Based on the regression of Type 8, we can conclude with 86.4% certainty that the range of a port site's amphora assemblage is correlated with the amphora's frequency by a coefficient of .065. It is observed at the Agora at Amathous, Kourion and the Theatre in Paphos, all dominated by amphorae from either the southern Levant, Cilicia/Asia Minor, or Cyprus. Its presence at the harbour context in Caesarea is the only example of a distribution to a relatively heterogeneous assemblage (range of 33.9), though this figure is likely an underestimation due to the lack of identified types in the analysis.

It is important to clarify that this does not indicate causation in any way, but simply correlation (Archdeacon 1994: 243-6; Pearl 2009: 42). In other words, it cannot be established statistically that the Beirut Type 8 was imported at a site *because* the site was importing from a single source (or more likely producing the majority of amphorae in the assemblage). Rather, this appears to be a simple case of correlation in the sense that the hinterlands of port sites in Cyprus and the Levant coincidentally were producing and packaging more wine and olive oil, as observed in the dominant sources outlined in Appendix F. This is observed in the 'small-world' hinterland of Caesarea, where amphorae produced at rural sites (primarily LRA 5 and Almagro 54) within 25 km of Caesarea and stored at the urban centre increase significantly in frequency in later periods

(Berlin 1992; Blakely 1988: 42; 1992; Johnson 1986; Gendelman 2012; Oleson et al. 1994; Reynolds 2005; Riley 1975). This is also the case at Ashkelon and its hinterland (Erlich 2017; Huster 2015; Israel 1995a; 1995b; Kogan-Zehavi 1999; Nahshoni 1999). A similar increase in capacity can be seen in the production and distribution of the LRA 1 amphora, produced in Cilicia/Asia Minor as well as Cyprus (Demesticha 2003; Demesticha and Michaelides 2001; Empereur 2018; Empereur and Picon 1989; García Vargas 2011: 78; Hodges et al. 2005: 241; Leidwanger 2011: 289-91; Piéri 2005: 74). For this reason, it is not possible to make any definitive statements regarding the distribution of the Beirut Type 8 amphora in relation to the type of amphora assemblages observed at the sampled port sites, because most eastern Mediterranean port sites were dominated by one or two types anyway.

8.1.2 **Commercial Trends in the Roman Levant and Cyprus**

In addition to the statistical character of each amphora assemblage, the frequencies based on the source observed at the sampled port sites can give clues as to regional routes involving Beirut. To explore this theme, this section discusses the results of the statistical analysis conducted regarding the correlation between the frequencies of types in each port site based on the source with the frequency of the Beirut Type. This highlights any distinct and statistically significant patterns that emerge on a wider scale by determining any negative or positive correlation (i.e., sites importing from source X generally were/were not importing from Beirut). For this test, the null hypothesis is that there is no statistical relationship between amphora frequencies based on the source. The statistical analysis is presented in the tables below and Appendix H.

Since Types 1, 4, 5, 6 and 7 are all extremely limited in their distribution (only one instance of Type 1 in Paphos and one instance of Type 5 in Apollonia that were quantified), this analysis has been conducted only for Types 3 and 8 first through a basic test of correlation, followed by regression analysis. Type 2 has also been omitted due to the lack of quantified ceramic assemblages where its presence was noted. This lack of statistical significance is depicted in H.1, with the regression indicating a p-value significantly higher than 0.10 (90% confidence interval), meaning that the null hypothesis must be accepted that there is no statistical relationship between Type 2 frequencies and other amphora frequencies within the sample. Sources have been differentiated based on a regional scale due to the frequent issues in identification encountered. More specifically, many observed types have not been sourced on a site-specific level (Kaldeli 2013b: Appendix 3.1; Reynolds 2000a; 2005). Thus, I have limited the range of sources to wider regions (Cyprus, southern Levant, central/northern Levant, Cilicia, Asia Minor, Greece, Egypt, North Africa, Spain, Gaul and Italy). Unfortunately, this minimises the prevalence of regional ceramic micro-trends within each area, but site-specific sourcing is not feasible given the current state of research. Future work will hopefully be able to build on this initial analysis as our understanding of ceramic trends improves, and provide an even more micro-centred focus.

Sites	*Central/ northern Levant (1)*	*Cilicia/Asia Minor (2)*	*Cyprus (3)*	*Egypt (4)*	*Gaul (5)*	*Greece (6)*	*Italy (7)*	*North Africa (8)*	*Southern Levant (9)*	*Spain (10)*
Central/ northern Levant (1)	**1.000**	0.198	-0.067	-0.109	0.611	-0.180	0.489	-0.066	-0.271	0.506
Cilicia/Asia Minor (2)		**1.000**	-0.133	-0.001	0.370	0.130	0.501	0.545	-0.587	0.307
Cyprus (3)			**1.000**	-0.044	-0.240	-0.474	-0.320	-0.276	-0.433	-0.423
Egypt (4)				**1.000**	-0.403	0.205	0.060	0.364	-0.177	-0.371
Gaul (5)					**1.000**	-0.014	0.824	-0.019	-0.337	0.700
Greece (6)						**1.000**	0.064	0.291	-0.177	0.477
Italy (7)							**1.000**	0.265	-0.423	0.399
North Africa (8)								**1.000**	-0.411	0.167
Southern Levant (9)									**1.000**	-0.294
Spain (10)										**1.000**
W. Med (11)										
Beirut 1										
Beirut 2										
Beirut 3										
Beirut 4										
Beirut 5										

Beirut 8	Beirut 7	Beirut 6	Beirut 5	Beirut 4	Beirut 3	Beirut 2	Beirut 1	W. Med (11)
-0.293	0.000	0.000	0.211	0.347	0.635	0.330	0.347	-0.259
-0.425	0.000	0.000	-0.257	-0.056	0.429	0.164	-0.056	0.526
0.312	0.000	0.000	-0.341	-0.148	-0.197	-0.051	-0.148	-0.492
-0.226	0.000	0.000	-0.271	0.742	-0.268	0.628	0.742	0.116
-0.207	0.000	0.000	-0.148	-0.148	0.789	-0.193	-0.148	0.213
0.131	0.000	0.000	-0.322	0.268	-0.039	0.242	0.268	0.514
-0.343	0.000	0.000	-0.185	0.194	0.542	0.126	0.194	0.462
-0.129	0.000	0.000	-0.105	0.056	0.243	0.029	0.056	0.786
-0.012	0.000	0.000	0.680	-0.116	-0.397	-0.197	-0.116	-0.281
-0.020	0.000	0.000	-0.178	-0.087	0.779	-0.113	-0.087	0.268
-0.060	0.000	0.000	-0.154	-0.154	0.142	-0.175	-0.154	**1.000**
-0.180	0.000	0.000	-0.083	1.000	-0.157	0.920	**1.000**	
-0.243	0.000	0.000	-0.112	0.920	-0.211	**1.000**		
-0.340	0.000	0.000	-0.157	-0.157	**1.000**			
-0.180	0.000	0.000	-0.083	**1.000**				
-0.180	0.000	0.000	**1.000**					

Table 8.1: Correlation between amphora frequencies from 13 contexts from Apollonia, Ashkelon, Caesarea, Amathous, Kourion and Paphos based on source; 95% certainty (p-value of 0.05) is at a correlation coefficient of 0.560 or higher (highlighted in red); 90% certainty (p-value of 0.10) is at 0.477 or higher (in blue)

Central/ northern Levant (1)	**S. Lev Sites**
1.000	*Central/ northern Levant (1)*
	Cilicia/Asia Minor (2)
	Cyprus (3)
	Egypt (4)
	Gaul (5)
	Greece (6)
	Italy (7)
	North Africa (8)
	Southern Levant (9)
	Spain (10)
	W. Med (11)
	Beirut 1
	Beirut 2
	Beirut 3
	Beirut 4
	Beirut 5

Beirut 3	Beirut 2	Beirut 1	W. Med (11)	Spain (10)	Southern Levant (9)	North Africa (8)	Italy (7)	Greece (6)	Gaul (5)	Egypt (4)	Cyprus (3)	Cilicia/Asia Minor (2)
-0.323	0.000	0.000	-0.348	-0.089	0.406	-0.172	-0.345	-0.382	-0.098	-0.639	0.000	-0.382
0.995	0.000	0.000	0.922	-0.045	-0.827	0.974	0.988	0.190	-0.017	0.876	0.000	**1.000**
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**1.000**	
0.879	0.000	0.000	0.670	-0.351	-0.561	0.759	0.800	-0.049	-0.328	**1.000**		
-0.103	0.000	0.000	0.367	1.000	-0.547	0.023	0.130	0.951	**1.000**			
0.094	0.000	0.000	0.529	0.946	-0.700	0.172	0.316	**1.000**				
0.973	0.000	0.000	0.970	0.103	-0.898	0.980	**1.000**					
0.977	0.000	0.000	0.925	-0.004	-0.821	**1.000**						
-0.773	0.000	0.000	-0.976	-0.524	**1.000**							
-0.131	0.000	0.000	0.341	**1.000**								
0.887	0.000	0.000	**1.000**									
0.000	0.000	**1.000**										
0.000	**1.000**											
1.000												

Beirut 8	Beirut 7	Beirut 6	Beirut 5	Beirut 4
-0.017	0.000	0.000	0.935	0.000
-0.251	0.000	0.000	-0.415	0.000
0.000	0.000	0.000	0.000	0.000
-0.518	0.000	0.000	-0.518	0.000
0.972	0.000	0.000	-0.434	0.000
0.880	0.000	0.000	-0.682	0.000
-0.106	0.000	0.000	-0.433	0.000
-0.208	0.000	0.000	-0.245	0.000
-0.336	0.000	0.000	0.618	0.000
0.978	0.000	0.000	-0.424	0.000
0.139	0.000	0.000	-0.513	0.000
0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000
-0.333	0.000	0.000	-0.333	0.000
0.000	0.000	0.000	0.000	**1.000**
-0.333	0.000	0.000	**1.000**	

Table 8.2: Correlation between amphora frequencies observed at four contexts from southern Levantine sites based on source; 95% certainty (p-value of 0.05) is at a correlation coefficient of 0.95 or higher (highlighted in red); 90% certainty (p-value of 0.10) is at a correlation coefficient of 0.9 or higher (highlighted in blue)

Cyp. Sites	*Central/ northern Levant (1)*	*Cilicia/Asia Minor (2)*	*Cyprus (3)*	*Egypt (4)*
Central/ northern Levant (1)	**1.000**	0.457	-0.979	0.028
Cilicia/Asia Minor (2)		**1.000**	-0.404	-0.393
Cyprus (3)			**1.000**	-0.194
Egypt (4)				**1.000**
Gaul (5)				
Greece (6)				
Italy (7)				
North Africa (8)				
Southern Levant (9)				
Spain (10)				
W. Med (11)				
Beirut 1				
Beirut 2				
Beirut 3				
Beirut 4				
Beirut 5				

Beirut 5	*Beirut 4*	*Beirut 3*	*Beirut 2*	*Beirut 1*	*W. Med (11)*	*Spain (10)*	*Southern Levant (9)*	*North Africa (8)*	*Italy (7)*	*Greece (6)*	*Gaul (5)*
0.000	0.358	0.788	0.294	0.358	0.520	0.859	-0.570	0.584	0.717	0.515	0.743
0.000	-0.092	0.400	0.182	-0.092	0.531	0.462	-0.892	0.143	0.394	0.213	0.455
0.000	-0.494	-0.658	-0.428	-0.494	-0.493	-0.749	0.485	-0.519	-0.724	-0.588	-0.668
0.000	0.866	-0.446	0.736	0.866	-0.458	-0.376	0.351	0.083	-0.109	0.685	-0.474
0.000	-0.197	0.804	-0.263	-0.197	0.888	0.750	-0.586	0.088	0.877	-0.125	**1.000**
0.000	0.810	0.108	0.824	0.810	-0.236	0.227	-0.295	0.546	0.070	**1.000**	
0.000	0.186	0.511	0.104	0.186	0.897	0.477	-0.529	-0.046	**1.000**		
0.000	0.354	0.514	0.317	0.354	-0.243	0.645	-0.212	**1.000**			
0.000	0.034	-0.587	-0.116	0.034	-0.555	-0.565	**1.000**				
0.000	-0.096	0.965	-0.126	-0.096	0.432	**1.000**					
0.000	-0.187	0.471	-0.146	-0.187	**1.000**						
0.000	1.000	-0.217	0.918	**1.000**							
0.000	0.918	-0.298	**1.000**								
0.000	-0.217	**1.000**									
0.000	**1.000**										
1.000											

Beirut 6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Beirut 7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Beirut 8	-0.507	-0.515	0.513	-0.126	-0.360	-0.586	-0.416	-0.064	0.684	-0.371	-0.341	-0.228	-0.312	-0.397	-0.228	0.000

Table 8.3: Correlation between amphora frequencies observe at nine contexts from Cypriote sites based on source; 95% certainty (p-value of 0.05) is at a correlation coefficient of 0.665 or higher (highlighted in red); 90% certainty (p-value of 0.10) is at a correlation coefficient of 0.582 or higher (highlighted in blue)

8.1.2.1 Type 3

In the correlation analysis, four significant ties with the Beirut Type 3 amphora frequency emerged: with Gaul, Spain and the central/northern Levant at 95% confidence, and with Italy at 90% confidence. This was calibrated based on the quantified presence at two Cypriote sites (Amathous at both the Agora and Palaea Lemesos, and Paphos at the House of Orpheus) and one southern Levantine site (Ashkelon). When conducted solely for Cypriote sites, the same patterns emerged at a higher rate (95% confidence), with a negative correlation with southern Levantine types and local Cypriote types (90% confidence). Regression analysis yielded similar results, with the Type 3 amphora being closely tied to amphorae from Gaul and the western Mediterranean (P-value of 0.05 for Gaul and 0.095 for W. Med, with an R Squared value of 0.99 indicating a very good fit of the data to the linear regression).

Thus, the Beirut Type 3 seems to be closely tied to the import of various western types, primarily from Spain and Gaul. Furthermore, the negative correlation with Cypriote types and southern Levantine types at port sites in Cyprus might be further indicative of regional trends prior to the growth in wine and oil production in Cyprus and the southern Levant. In other words, Cypriot sites that were importing western types were also importing the Beirut Type 3 amphora, while those characterised by primarily local types or southern Levantine types were not. Furthermore, central/northern Levantine types did not reveal any statistically significant correlation at southern Levantine sites, but each pair with western Mediterranean types and those from Cilicia/Asia Minor revealed a weak negative correlation.

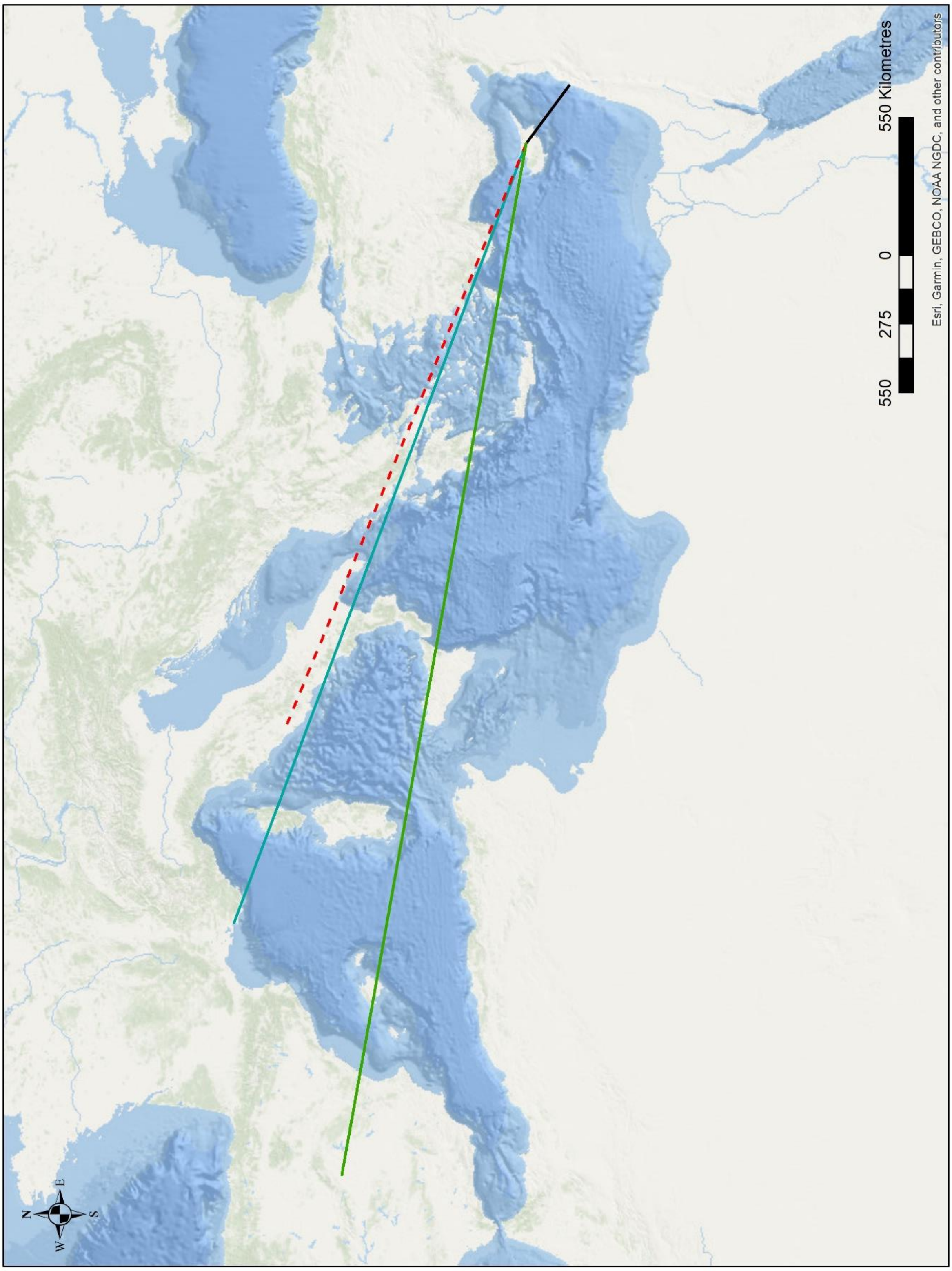

Figure 8.8: A graphical depiction of the results of correlation analysis; the solid lines represent connections at 95% confidence, and the dotted line represents a connection at 90% confidence

This is indicative of two things. Firstly, this supports the suggestion that Cyprus served as an important transit point in Mediterranean-wide commercial networks throughout the Roman period (Kaldeli 2009: 366-7; 2013a; 2013b; Lund 2005: 49). The correlation of amphorae from

Gaul, Spain and Italy (to a lesser extent) with the Beirut Type 3 amphora suggests that they were imported together, or not at all. Given that Beirut amphorae have been noted at sites in the western Mediterranean (section 8.1.3), combined with the suggestive maritime routes based on wind regimes and current patterns (Chapter 3), Cyprus can be confirmed as the first stop for merchants travelling west from Beirut. Secondly, the negative correlation with local types may be indicative of a distinct differentiation between ports with a primarily regional focus from those with a diverse and heterogeneous assemblage. This is further corroborated by the negative correlation between Spanish amphorae with Cypriote types, as well as with southern Levantine amphorae, at Cypriote port sites. Sites that were characterised by primarily local types generally did not import amphorae from any non-local sources, whether from the western or eastern Mediterranean. This may be reflective of differences in the status of clientele, since there is a dearth of Spanish, Gaul, and Beirut amphorae at Palaea Lemesos (apart from a single sherd of a Beirut 3 amphora), but higher frequencies at 'higher status' sites such as the House of Orpheus and Theatre at Paphos and the Agora in Amathous.

8.1.2.2 Type 8

Results of the Type 8 analysis indicate a correlation of 0.684 between southern Levantine amphora frequencies and the Beirut Type 8 (95% confidence) at Cypriote port sites. Regression analysis did not corroborate this connection, with a high Significance F value of 0.80 and every P-value being greater than 0.50 (resulting in the acceptance of the null hypothesis that there exists no relationship between the frequencies of imported amphorae and the frequency of the Beirut Type 8 amphora). However, the correlation coefficient of southern Levantine types and the Beirut Type 8 amphora reflects a similar pattern to that discussed in section 8.1.1.2, with a high degree of correlation between the dominant, widely-distributed LRA 5 amphorae and the Beirut Type 8 amphora. Again, this may be circumstantial (see 8.1.1.2.2).

8.1.3 **Directionality**

To explore the reciprocity of commercial relationships between *Berytus* and the sampled port sites, I have included the variable of 'directionality' in analysis. Directionality is assessed in this section by comparing the quantified amphora assemblage uncovered in Beirut (presented in Table 8.4 and graphically depicted in Figure 8.9) to the distribution of the Beirut Type. However, it must be recalled that this does not necessarily suggest a direct exchange of products. Rather, the measurement determines whether one site was primarily exporting to or importing from the other, or if the distribution balance was closer to 0 on a macro scale. This has been conducted in this thesis by comparing the imports quantified by Reynolds for BEY 006, 007, and 045 (Reynolds

2000a: 1056, Table 1) with the distribution of the Beirut Type. These contexts are representative of those from the city centre (006 and 045) and the port area analysed in Chapter 5 (007). Piéri also briefly discusses ceramic trends in *Berytus* based on the sites of BEY 002 and 026, though these analyses are preliminary and qualitative in nature, requiring formal identification and quantification (Piéri 2007).

Clearly, based on these imports, Beirut appears to be quite well-connected, importing material from a wide variety of sources both locally and internationally (Reynolds 2010). Primary imports come from the southern Levant, specifically Akko and Caesarea (LRA 5 and Almagro 54, with a particularly high concentration between the 2nd and 4th centuries AD, and Agora M334 amphorae from Akko in the 4th century AD), and Cilicia/Cyprus (10.36%, LRA 1, dated roughly to the 4th and 5th centuries AD) (Reynolds 1999: 41, 54, 109; 2005: 574). 10.12% have been preliminarily sourced to Sidon, though no workshops in use in the Roman period have been uncovered at the city, so this connection remains unclear. The remaining percentages all represent less than 10% of the total assemblage of imported amphorae, with a wide range of sources from the eastern and western Mediterranean.

Sherds (diagnostics)	**% of Total Imports**	**Source**	**Reference**
111	4.62%	Spain	Reynolds 2000b: 1056, Table 1
78	3.25%	Tunisia	Reynolds 2000b: 1056, Table 1
28	1.17%	Italy	Reynolds 2000b: 1056, Table 1
4	0.17%	Gaul	Reynolds 2000b: 1056, Table 1
326	13.57%	South Lebanon	Reynolds 2000b: 1056, Table 1
240	9.99%	Northern Levant	Reynolds 2000b: 1056, Table 1
797	33.17%	Southern Levant	Reynolds 2000b: 1056, Table 1
27	1.12%	Cilicia	Reynolds 2000b: 1056, Table 1
249	10.36%	Cilicia or Cyprus	Reynolds 2000b: 1056, Table 1
21	0.87%	Crete	Reynolds 2000b: 1056, Table 1
26	1.08%	Greece	Reynolds 2000b: 1056, Table 1
36	1.50%	Unknown	Reynolds 2000b: 1056, Table 1
29	1.21%	Asia Minor	Reynolds 2000b: 1056, Table 1
189	7.87%	Achaia	Reynolds 2000b: 1056, Table 1
36	1.50%	Rhodes	Reynolds 2000b: 1056, Table 1
59	2.46%	Pontus (Black Sea)	Reynolds 2000b: 1056, Table 1
131	5.45%	Eastern Med.	Reynolds 2000b: 1056, Table 1
16	0.67%	Egypt	Reynolds 2000b: 1056, Table 1
2403	**100.00%**		

Table 8.4: Imported amphora sherds uncovered at BEY 006, 007 and 045, and categorised based on source (after Reynolds 2000b: 1056: Table 1)

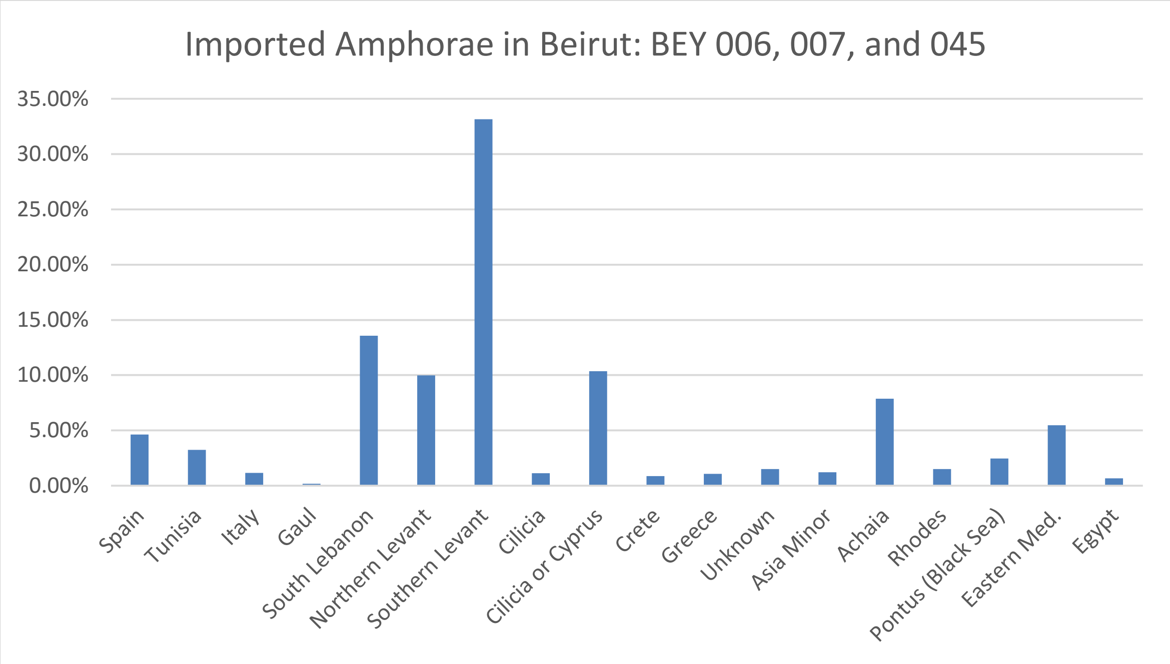

Figure 8.9: Bar chart depicting relative frequencies of imported amphorae in Beirut (after Reynolds 2000b: 1056, Table 1)

BEY 002 and 026 reveal a similar pattern in the later periods, though the assemblage uncovered from these sites is dominated by LRA 1 amphorae probably from Cyprus, with southern Levantine types being the second most common (Piéri 2007: 299-306). Similar southern Levantine types are encountered, including LRA 5, LRA 6, Almagro 54 and Agora M334 (Piéri 2007: 304-6). Piéri also notes the presence of LRA 5/6 amphorae sourced to Egypt within the assemblage (Piéri 2007: 305). He concludes that there existed several prevalent commercial connections in the late Byzantine period with Cyprus, Palestine, Egypt, Cilicia and Asia Minor (Piéri 2007: 311).

There is clearly an imbalance of distributions between the southern Levant and Beirut, especially in the later periods. In this analysis, the contexts in which Beirut Type amphorae were observed in the southern Levant prove to be quite significant. Specifically, at Akko, Apollonia and Caesarea, the instances of Beirut Type amphorae were found in harbour contexts, and were not encountered in any terrestrial assemblages, whether residential areas, storage facilities, or administrative buildings. This indicates that merchants were sporadically transporting the containers on their journeys south, but the instances observed could be evidence of distributions in transit (on the way to Egypt or further west on the North African coast), as opposed to final arrivals. This imbalance also correlates with the loss of territory in the Bekaa in 193 AD (Perring et al. 2003: 212-4). Given that most veterans were probably settled in this region, and the surplus they produced likely composed a majority of the products packaged in Beirut Type amphorae, there would have been an increase in demand for wine at the port city after the separation of Baalbek and its incorporation into a more regional, inland market involving north-western Syria

(Hamel 2014; Reynolds 2014). This demand could have been filled in part by the high-quality wine of the southern Levant, which was praised by ancient authors (Sperber 1978: 66), and comprised an industry that had grown immensely over several centuries. This imbalance also seems to apply to other regional types, including Levantine types from Amrit/Tarsus and northern Lebanon (Reynolds 2005: 568). These types are common in 2nd to early-3rd century deposits in Beirut, again coinciding with the loss of territory in the Bekaa, and the drop in distributions starting with the Beirut Type 4.

In terms of the LRA 1 finds in Beirut, it must be recalled that early examples of the type have largely been sourced to Cilicia, with production on Cyprus beginning in the 6th and 7th centuries AD (Empereur and Picon 1989; Keay and Williams 2014). Thus, early specimens observed in Beirut should be taken as Cilician imports, while later forms may have come from either Cyprus or Cilicia (only 5 sherds, or 0.21% have been established as the earlier forms, dated to the 3rd century AD from Cilicia, so the numbers presented in Table 8.4 are more reflective of the later LRA 1 forms produced at Cyprus and Cilicia). The degree of reciprocity between Beirut and Cilicia is unclear, though future publications of ceramic reports from sites in Cilicia might help clarify the situation. Some reciprocity is attested between the Aegean region and Beirut, as seen in the presence of the Beirut Type at Athens (Types 2 and 8), Knossos (Type 3), and possibly at Fourni (personal communication with Peter Campbell) (Forster 2009: 92; Hayes 2000: 290, 296). However, this proposition is based only on presence/absence data and requires more in-depth quantification for further clarification.

There is an increase in imports from Spain and Italy in the early imperial period, shortly after Roman colonisation. This trend diverges from previous western Mediterranean imports, which predominantly come from North Africa before the late-1st century BC, along with Rhodian, Knidian and Koan amphorae (Ala Eddine 2003: 117). This could be related to the influx of settlers, with the change in the amphora assemblage reflecting the tastes of a new clientele in the colony.

8.2 The Distribution Networks of *Berytus*

Two distinct maritime routes appear to have been quite prevalent based on the distribution of the Beirut Type in the 1st and 2nd centuries AD: one through Cyprus and one along the coast of the Levant. The connection between the central/northern Levantine coast with Cyprus based on environmental maritime factors is well-attested (Blue 1995: Chapter 6; Safadi and Sturt 2019), with the westward journey from Beirut being most feasible on Spring mornings and possibly in Winter, and travelling to Beirut from Cyprus aided by favourable winds throughout the year apart from Winter (3.2.1). Thus, the concentration of Beirut Type finds in Cyprus (relatively, compared to the paucity of evidence observed elsewhere) seems to be associated with these 'natural' trends. This is supported by the fact that the Type 2 amphora is completely absent in southern Levantine sites, but is present in Cyprus, Greece, North Africa and Egypt. Travelling south from Beirut is quite difficult apart from a small window where winds aided merchants' journey on Spring mornings. Thus, from the early-1st to early-2nd centuries AD, it appears that a route through Cyprus was most prevalent, and connected Beirut with the wider Mediterranean. As observed in Chapter 3, the north-eastern region of the Mediterranean is more erratic in terms of wind regimes and currents, especially compared to the fairly consistent and predictable Etesian winds on the Levantine coast and Cyprus. This would have made Cyprus an even more attractive transit point (Arnaud 2004: 3-4). Furthermore, travel between Cyprus and Lebanon is best facilitated in the Spring and Summer months, at a time when grapes would have been harvested and turned into wine, also allowing for several months for terrestrial transportation and packaging before maritime distribution.

This may be reflective of a continuation of important maritime routes in the Hellenistic period, which saw over 80% of amphorae in Beirut coming from a local source (probably Sidon), and intra-regional imports dominated by Greek and Cypriote sources (Ala Eddine 2003; Aubert 2003; Élaigne 2007: 122-3), as well as a significant quantity of fine ware from Greece (Aubert 2007). This connection is also attested through an inscription found in Greece from 166 BC, which suggests a significant presence of Berytans in Delos, more so than other Levantine sites such as Tyre and Sidon (Arnaud 2001-2002: 176). Similarly, amphorae in Hellenistic Cyprus were predominantly Rhodian or generally from the Aegean (Dobosz 2013).

The Type 3 amphora came into production at the end of the 1st century AD, which is correlated with the rise of southern Levantine imports observed in Beirut, specifically from the regions of Akko, Caesarea and Ashkelon (see section 8.1.3). It seems likely, given this trend in the amphora data as well as the lack of correlation between the distribution of western types and the Beirut Type at southern Levantine sites, that this involved a coastal route between Beirut and the southern Levant. This is supported by the presence of Type 3 at various geographical spacings throughout the southern Levant. A similar well-distributed, multi-site set of assemblages might be reflective of a journey from south to north, as attested in the presence of Almagro 54 and LRA 5/6 types (produced in the southern Levant) in Tyre (Gatier et al. 2011: 72-75), Jiyeh (Wicenciak 2016b: 114) and Beirut (see above). Furthermore, as mentioned in the previous chapter, there is a distinct discontinuity between the distribution of the Beirut Types 2 and 3, with only Paphos and Marina el-Alamein importing both types. No Beirut Type 2 were noted at southern Levantine types, suggesting that the distribution of Beirut Type 3 vessels in this region represents a relatively new endeavour. This also supports the emergence of a coastal route after the development of Beirut Type 3 amphorae in the late-1st century AD, and distinct from that associated with the Beirut Type 2 amphora.

Given the lack of reciprocity between southern Levantine sites and Beirut (see section 8.1.3), it seems likely that merchants from the southern Levant travelled to *Syria Phoenice* with the intention of distributing wine packaged in Almagro 54 and LRA 5/6 containers. The return journey (or initial one depending on the merchant's point of origin) might have been undertaken with a heterogeneous cargo of wine and products not packaged in amphorae. This might have included textiles and garments, which were commonly produced in Beirut as at a number of other Syrian cities, as well as the famous purple dye of the Levantine coast (Pliny *HN*. 12.76; Butcher 2003: 174, 211-2; Hall 2001-2002: 153-4; Millar 1993: 266). In this way, *Berytus* wine might have been one of many products as part of a higher value cargo, which might explain its low-frequency distributions. Additionally, given the difficulty in sailing south from Beirut throughout the year (Chapter 3 and 8.1.1.1), perhaps the lack of commercial reciprocity is suggestive of the prevalence of the journey from south to north along the Levantine coast, and a different return from the northern Levant to the port of origin.

Ultimately, the high frequency of Beirut Type amphorae observed in Beirut and other production centres of the Type 2 amphora (6.4.2) (Reynolds 1999; 2000a; 2000b; Wicenciak 2016b), when compared to the paucity in regional port sites, indicates that the type indeed was not distributed in any significant capacity. In other words, there does not appear to have been any consistent, large-scale patterns similar to those observed in the distribution of amphorae from Baetica to Rome (Keay 2016: 306-307), Africa to Gaul (Long and Duperron 2011), Greece to the eastern Mediterranean in the Hellenistic period (Ariel 2005; Arnaud 2001-2002: 175; Aubert 2003; Coulson et al. 1997), or the southern Levant to the eastern Mediterranean in the Late Roman period (see above). In those cases, the sheer frequency of distributions suggests some degree of premeditation; merchants involved in these networks had a preconceived intention to transport a substantial quantity of product to a specific site.

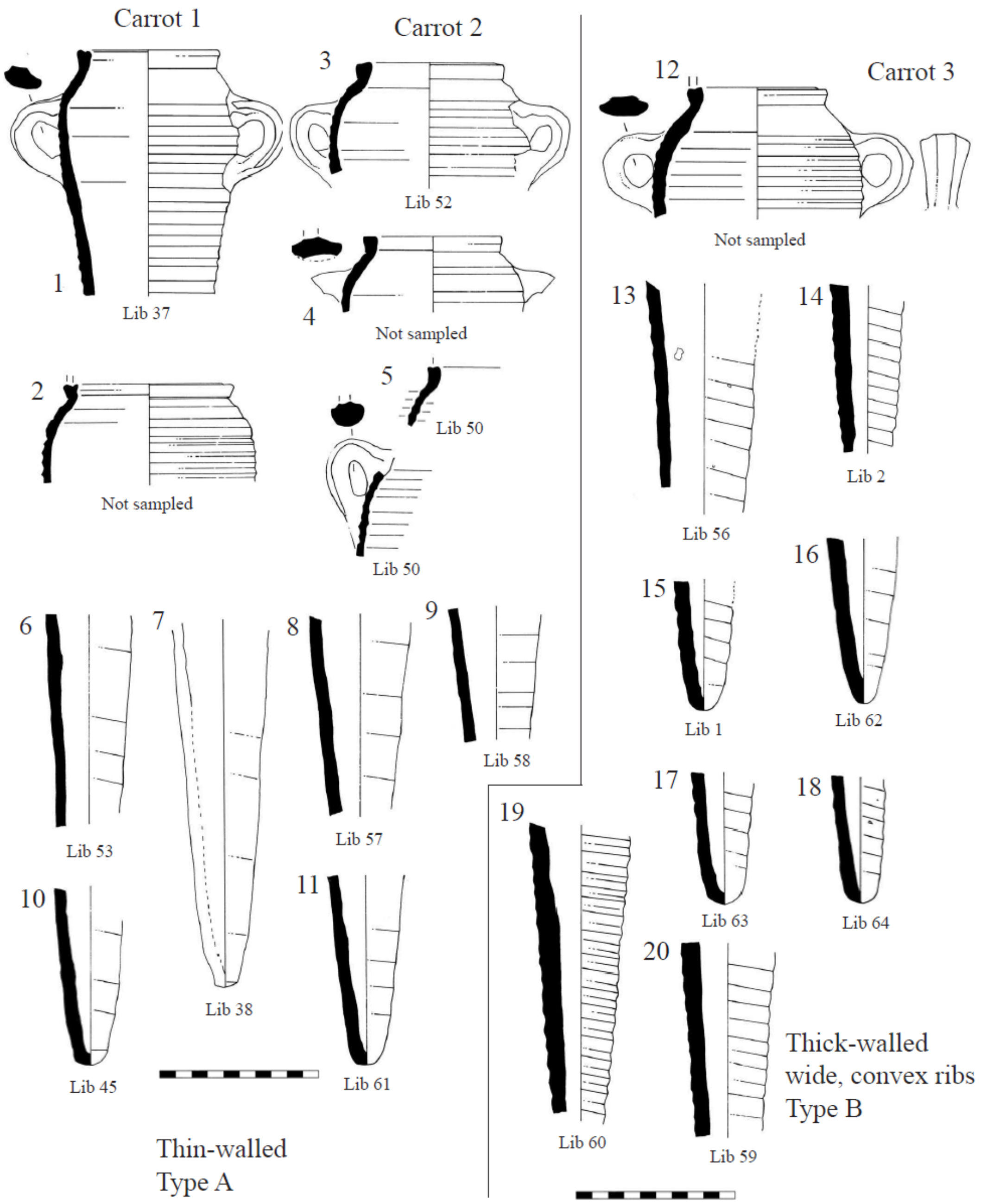

Figure 8.10: 'Carrot-type' amphorae produced in the BEY 015 workshop, presumed to have carried dried fruit (after Reynolds et al. 2010: 103, Fig. 7)

8.3 Conclusion

Despite the paucity of evidence, statistical analysis of the distribution of the Beirut Type proves to be quite revealing in terms of commercial patterns in the eastern Mediterranean. The relationship between the Beirut Type's distribution and geographical distance gives a measure of closeness, the degree centrality assesses the prevalence of the port city's assemblage in commercial patterns, correlation and regression analysis of different amphorae with the Beirut Type sheds light on intra-regional re-distributions and transit ports, and directionality explores the relationship between *Berytus* and each port site. Ultimately, it is through a combination of all the analyses conducted that a more definitive picture of maritime commercial networks involving *Berytus* emerges.

Chapter 9 The Organisation of the Export of Beirut Amphorae

Having outlined distribution routes and explored possible correlation between amphora types to propose commercial patterns, I now incorporate the data presented in previous chapters to provide a holistic view of the economy of *Berytus*. My intention is to characterise the various steps in the supply chain of agricultural products (primarily wine), and compare the resulting patterns to other regional and intra-regional economies in the Roman Empire.

9.1 The Independence of *Heliopolis*

A combination of all lines of data discussed in this thesis suggests several conclusions regarding socio-economic fluctuations and political changes in *Berytus*. Firstly, the drop in exports in the late-2nd century AD supports the proposition that Baalbek transported its products to Beirut for packaging, which might have stopped after the independence of *Heliopolis* from *Berytus* as a separate colony in 193 AD (Millar 1993: 218, 221). This is also corroborated by ceramic trends from Baalbek; in the Hellenistic period, it was involved in regional supply networks with no evidence of the penetration of ceramics from the coast inland (Hamel 2014: 67). In the Early Imperial period, this changed with the appearance of Koan amphorae, ESA, as well as various non-local ceramics also uncovered at Caesarea and Beirut (Hamel 2014: 69). These parallels suggest that there was some penetration of imported ceramics inland, possibly associated with the newly-settled veterans of Augustus. Finally, after the independence of the city, the city began producing its own distinct form of amphora (Figure 9.1; Hamel 2014: 69-70; Wicenciak 2016a: 673-5). At this time, regional networks became dominant again, even in the case of fine wares, which appear to have been locally-supplied (Hamel 2014: 70). Thus, it seems reasonable to attribute the divergent phase during the Imperial period to the city's incorporation into the territory of *Berytus*. After Baalbek's independence, it developed different distribution networks which essentially decreased movement to and from the urban centre of *Berytus*, and allowed for the new colony to distribute its product locally.

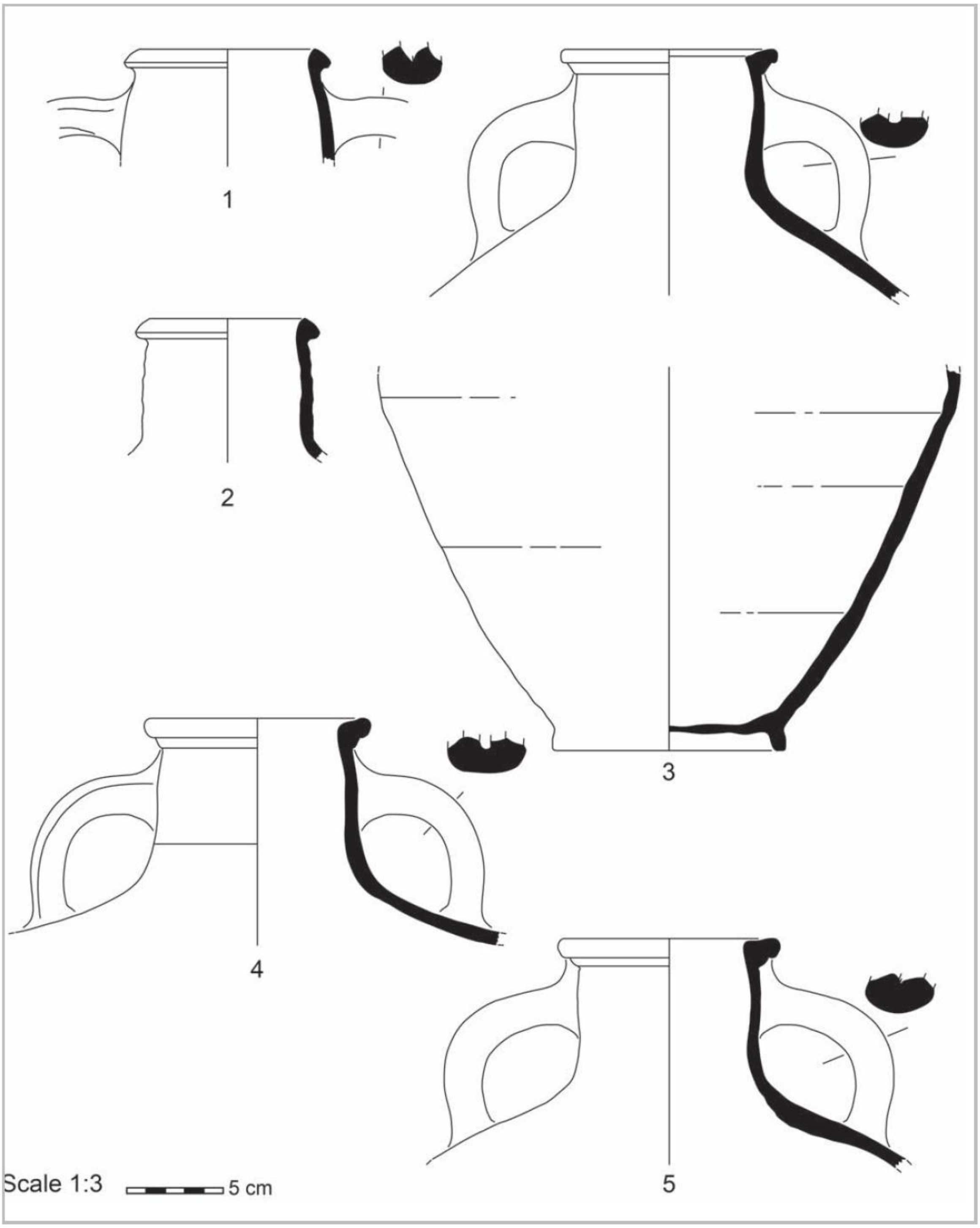

Figure 9.1: A locally-produced table amphora produced and found in Baalbek (after Hamel 2008: 208, Pl. 3)

Furthermore, the trend of oleiculture being more prevalent in coastal areas and the Mount Lebanon Range (EZ 1 and EZ 4) than in the Bekaa (EZ 5) supports the proposition that the Beirut Type primarily packaged wine (Reynolds 1999; 2000b; 2005; Woodworth 2011). Given that I am arguing the drop in exports after the halt of production of the Beirut Type 3 amphora is largely associated with Baalbek's independence, and assuming that Baalbek was largely specialised in viticulture (Fischer-Genz 2016), it can be asserted that this reflects a drop in the export of specifically wine. This is not to suggest that viticulture and oleiculture were limited to one area or another; rather, the difference in concentrations of presses and crushers can only be taken as a sign that the Bekaa was more focused on wine than olive oil. These corroborative data, combined with the distribution of Latin and Greek inscriptions in the Bekaa and ancient texts discussing the new colony of *Berytus* (Chapter 6), also definitively confirm that *Heliopolis* and much of the Bekaa were initially included as part of the colony (Abou Diwan and Doumit 2016; 2017; Hosek 2012: 46-53; Perring et al. 2003: 208).

9.2 Administrative Organisation of Production

These trends, however, do not necessarily indicate any degree of central control of viticulture and oleiculture, as has been suggested in the past (Perring et al. 2003: 208; Reynolds 1999; 2005). Specifically, Reynolds has argued that the municipality commissioned the production of wine on publicly-owned land, and cited the stamping of the Beirut Type 2 amphora as evidence of ownership (Reynolds 1999: 50). This is definitely a possibility, as municipalities commonly owned land throughout the Roman Empire, which they either managed themselves or leased for profit (Bowman and Wilson 2009: 27; Brigand 2011-2012: 22; Hobson 2012: 226; Keay 1984: 417; Kehoe 2007: 85; De Nardis 1994: 5).

However, the characterisation of the stamp must be carefully examined, as it is quite rare for amphorae to be stamped with the name of the colony. It has been observed on amphorae from North Africa (Franco 2012: 83), specifically *Sullecthum* (Keay 1984: 108), *Tubusuptum* (*Tubusuctus*, or modern-day Tiklat) (Keay 1984: 431), *Neapolis* (Panella 1972; 1973), *Hadrumetum* (Keay 1984: 410) and *Leptiminus* (Keay 1984: 123), with the latter three prefixing the name of the town with 'COL', similar to Beirut. Each of these sites seems to have been characterised by different types of production. *Sullecthum* primarily produced oil and fish sauce (Taylor et al. 1996: 10-11). *Neapolis* mostly produced oil and fish sauce, with the stamp *CIN* (*Colonia Iulia Neapolis*) occurring on Africana 2 amphorae, possibly also suggesting wine (Bonifay 2016: 596; Keay and Williams 2014). *Leptiminus* and *Hadrumetum* are associated primarily with olive oil production (Keay 1984: 408-10), though fish sauce and wine are also likely (Bonifay 2004; Keay and Williams 2014). Reynolds has interpreted these stamps as indicative of central control, reflecting some degree of state organisation in the production and distribution of these products (Reynolds 1999: 49-50). Yet the production of fish sauce and wine at some of these sites, and the stamping of amphorae from *Hadrumetum* and *Leptiminus* occurring on Africana 2A and 2D types (generally associated with fish sauce or wine; Bonifay 2004; Keay and Williams 2014), diminishes this theory, since fish sauce and wine are usually regarded as products not dictated by central control (McCann 1987: 39; Purcell 1985; Tchernia 2016: 7). Moreover, as Keay notes, the stamps for certain sites often occur in a variety of formats. At Hadrumetum, these include 'COL HADR', 'COL HADRV', 'C. HADR', 'HADR', 'HMDT', and 'CHDR', while at Tubusuptum, these include 'EX O IVLI/HONOR/PMC TVB', 'EX PROV/MAVR CES/TVBVS', 'MAVR CAES/TVBVS' (Panella 1973: 633), and 'EX PRO/MAUR CAES/DEPRFONT' (Mayet 1978: 389). This range of stamping formats for one city possibly reflects some degree of individual agency between each workshop (Keay 1984: 410; 431). Thus, if these workshops are to be used as appropriate comparisons, I propose here that the stamping of the Beirut Type 2 amphorae may not necessarily indicate centralised control of production of every aspect of the supply of wine from the hinterland to the city. Rather, it may have been conducted simply to specify the source of the product. Given that it only occurs on the earlier Beirut Type 2, it may have served to differentiate the wine of *Berytus* from that of other Levantine regions, and indirectly or directly, the new, favoured colony from other sites (Hall 2001-2002: 143). Furthermore, it must be recalled that the Beirut Type 2 stamp has only been found on a handful of sherds from a sample of several thousand, and should not be taken as any significant, widespread practice (Wicenciak 2016a: 655).

If these stamped vessels can indeed be shown to reflect the commissioning of production by the municipality, or the collection of taxation in kind, this would not have applied to the regional production centres of Jiyeh and Khalde, since none of the uncovered vessels from those sites were stamped (Reynolds 2005: 569; Wicenciak 2016b: 78). Regarding Jiyeh, this also applies to the earlier Sidon 2 form, which is known to have been stamped, as seen in examples from Beirut (Aubert 2007; Finkielsztejn 1998: 91-5; Wicenciak 2016b: 43). Given that Khalde was probably included in the territory of *Berytus* (Gwiazda 2014: 61; Wicenciak 2016b: 22), it seems more likely, rather, that these sites were simply mimicking a successful market, and that the production of this distinct new type in several different workshops simply reflects a shift in ceramic trends as opposed to administrative changes (Núñez 2015; Peña 2007: 33-5).

The term 'central control' is also quite vague in understanding every facet of land ownership, administration, taxation and packaging, and might not be appropriate in shedding light on production trends in the colony of *Berytus*. This is supported by the settlement of Roman veterans in the colony, which complicates our characterisation of the economic infrastructure behind viticulture in Roman Beirut. More specifically, apart from veteran-owned lands, which would have surely fallen under the jurisdiction of the *ius italicum* (a rare honour in Roman Syria at this time) (Campbell 2000: 334-5; Sherwin-White 1939: 276), it is difficult to assess the extent of privately-owned lands in the colony. As a result, we are left to question whether the indigenous population was subject to taxation payable to *Berytus*, or if their lands were included within the general *ius italicum*. This inquiry has been addressed by scholars in the past regarding other colonies in the Empire (Campbell 1996: 97), with no resolution.

These considerations are important because they help specify what kind of transaction the Beirut Type represents. If it can be shown that the newly-settled veterans were transporting their wine to the urban centre for packaging, this might be more closely characterised with a private endeavour rather than the payment of taxation (Campbell 1996: 97; Fentress 1979: 178; Keppie 2000: 312). Rather, if some of the amphorae were used to package wine produced on lands owned by the non-veteran population, there is the possibility that it might reflect a surplus collected as municipal taxation (Campbell 2000: 43; Perring et al. 2003: 208). Additionally, if the city owned municipal plots which it either managed or leased (Bang 2009: 205; Campbell 2000: 474), some of the resulting agricultural product might have been packaged in the Beirut Type as a form of rent or taxation (Butcher 2003: 190; Millar 1993: 196-7). The truth of the matter is it is quite difficult to differentiate between each of these possible scenarios, especially considering the fact that most of our knowledge of taxation in the Roman Empire comes from textual references regarding exceptional situations and sites (Brunt 1981: 162; Butcher 2003: 193; Rathbone 2000; 2005).

The most likely possibility is that a number of types of transactions took place at this time that cannot be comprehensively labelled as 'private', 'public', 'centrally-controlled' or 'market-centred'. The stamping of the Beirut Type 2 amphora might be associated with product collected as taxation in kind, or to mark products of municipal lands; but given that the type represents the primary form for the packaging of any wine and oil in the colony (Reynolds 1999: 51, Table 1), surely some of the amphorae were used to package some quantity of privately-manufactured products. After all, if two legions were indeed settled in *Berytus*, this represents a substantial population of roughly 10,000-12,000 veterans and their families (estimate based on Livy 23.34.12, 40.26.8-9; Sall. *Bell. Jug*. 84.2, 86.4; Keppie 2015: 64; MacMullen 1980: 452; Roth 1994: 346; 2012: 20-21). Given that a large portion were settled in Baalbek and Hosn Niha (Strabo XVI.2.19; Ulpian 50.15.1.1; Hosek 2012; Millar 1990: 19-20; Newson and Young 2018: 164; Sartre 2001: 646, 706; Sawaya 2009: 186-97), and Baalbek was specialised in viticulture (Chapter 6), it is likely that the Roman settlers were responsible for a significant portion of the wine reaching the urban centre of *Berytus*. The vessels used to package this wine would then represent a private product independent of taxation, since veteran land would have fallen under the jurisdiction of the *ius italicum*, and made it exempt from the *tributum soli*, or land tax (Butcher 2003: 190, 230).

Additionally, there is the consideration of private land ownership by non-veterans, which is attested in the coastal region of *Berytus* in the Imperial period and the Late Roman period (4th and 5th centuries AD) (Lib. *Ep*. 877; *Or.* 1.265; Hall 2004: 105-9; Norman 1992). It is impossible to specify what proportion of the packaged amphorae uncovered at Beirut and surrounding port sites was contributed by private producers. However, if they indeed were able to produce a surplus of wine or oil after taxation, and intended to sell this product beyond the immediate vicinity, this would have been conducted at the urban centre of *Berytus*, or possibly at Khalde or Jiyeh (Reynolds 1999: 51; 2005: 569; Wicenciak 2016a: 648; 2016b).

Finally, ancient sources and archaeological evidence of pressing installations throughout the Mediterranean indicate a significant investment associated with the construction and maintenance of a pressing site (Cato *De agricultura* 12-13; Col. *De re rustica* 12.52.8; Mattingly 1988b: 50-1; 1996; Purcell 1985: 13; Taxel 2009: 2013; Waliszewski 2014: 272; Wilson 2002: 6). This also sometimes involved a substantial labour force depending on the size of the agricultural site and the capacity of production of wine or olive oil (Cato *De agricultura* 10). Thus, regardless of the legal jurisdiction of a plot of agricultural land, it must be recalled that viticulture and oleiculture in *Berytus* involved the employment of a significant population (or the exploitation of slaves) (Rathbone 2003: 205). Therefore, the presence of a Beirut Type, whether locally or at a distant port site, is a representation of this whole process (Broekaert and Zuiderhoek 2020: 104-5; Peña 2007: 1).

9.3 Distribution Through the Port of *Berytus*

The complexity of Roman legal and economic administration is further emphasised in the consideration of the subsequent distribution and/or consumption of these products. In other words, the adherence to the dichotomy of private or public simplifies two separate processes dictated by different factors. Scholars focused on macro-economic trends often group all steps in the supply chain as a single entity (Bang 2009; Frier and Kehoe 2007; Morris et al. 2007). While useful for Empire-wide studies, this does not provide the most accurate analysis of specific sites. In this section, I address this issue by differentiating the concepts discussed in 9.1 and 9.2 from the processes that governed subsequent distributions..

9.3.1 Merchant Ships Passing Through *Berytus*

In the past, scholars have generally categorised Roman merchant ships based on wide-ranging cargo capacities through the examination of ancient texts and selective archaeological data (Broekaert and Zuiderhoek 2020; Casson 1995; Rathbone 2003). Such an approach is useful in Empire-wide studies, but does not account for the high degree of regionalism in shipbuilding traditions and changes over time on a smaller scale (McGrail 2009; Whitewright 2018: 34, 38, 41). This is quite clear in the comparison between merchant river barges dated to the Roman period found in northern Europe and Croatia (among other regions) (Gaspari et al. Hazenberg 2013; McGrail 1998; de Weerd 1978), seagoing vessels uncovered in the straights between Corsica and

Sardinia (Boetto 2012; Parker 1992: 134-5, n. 283; 174, n. 392; 240, n. 586, among others) and ships dated to the Byzantine period found along the southern Levantine coast (Barkai and Kahanov 2016; Cohen and Cvikel 2019; Kahanov and Mor 2014; Navri et al. 2013). Each tradition seems to have been highly-specialised to serve a defined function, and adapted to sail effectively in specific environments (McGrail 1998: 194-202; Whitewright 2018: 30). Another issue in the broad classification of Roman vessels is the fact that based on recent research, it seems that smaller vessels may have been responsible for a high percentage of commercial maritime distribution, especially in the Imperial period onwards (Arnaud 2011: 71; Boetto 2010; 2012; Broekaert and Zuiderhoek 2020: 110-1). This warrants a more detailed classification system that differentiates between different capacities of vessels that fall within the classical definition of 'small vessels' (generally regarded as under 70 tons) (Leidwanger 2013a: 202-205; Parker 1992: 26; Rathbone 2003)

Based on shipwreck data of vessels uncovered throughout the Mediterranean, Roman cargo ships generally ranged in length from 15-16m to around 40m, and in width from 5m to 10/12m between the Late Republican period to the Late Byzantine and Early Islamic periods (Table 9.1; Whitewright 2016: 875-6). Though ancient texts might indicate that larger vessels existed, they have not been identified in the archaeological record (such as the notorious *Isis*) (Wilson 2011b: 40). As seen below, and postulated by scholars (Arnaud 2011; Boetto 2010; Leidwanger 2007; 2014; Whitewright 2018), smaller vessels appear to have been quite prevalent in maritime commerce in the Roman period, especially after the 4th century AD. In terms of the translation of these physical specifications into harbour accessibility, the measurements of width and draught appear to be quite important. This is because the width of a vessel dictates the amount of docking space it would require (assuming it is docking perpendicular and not parallel to the quay, and also based on the traffic at the time of docking) as well as whether the vessel could actually physically enter the harbour (Wilson et al. 2012: 383). Furthermore, vessels could only enter harbours with a certain water depth based on their draught (Boetto 2012: 157).

Wreck Name	Find Location	Date	Cargo	Length	Width	Draught	Tonnage	Source
Bourse de Marseille	Marseille	3rd AD	Amphorae?	24	9	2.2/2.3		Boetto 2010
Cavallo 1	Corsica/Sardinia	mid-1st AD	Amphorae, glass vessels					Parker 1992: 134-5, n. 283
Dor 2001/1	Dor	early 6th ad?	Amphora, ceramics	16.9	5.4	1.5	50	Kahanov and Mor 2014
Dor 2006	Dor	6th-7th	Ceramics	25		3.5	170-200	Navri et al. 2013
Est Perduto 1	Corsica/Sardinia	early 1st AD	Amphorae		10			Parker 1992: 174, n. 392

Est Perduto 2	Corsica/Sardinia	130-90 BC	Amphorae	20	12	?		Boetto 2012: 165-66, Table 8.2
Fig Tree Bay	Cyprus	2nd-3rd AD	Amphorae	?	?	?	4-5	Leidwanger 2013a
Fiumicino 1	Rome	4th-5th AD	Misc.	17.18	5.59	1.4	50	Boetto 2010
Fiumicino 2	Rome	4th-5th AD	Misc.	19.18	6.27	1.57	70	Boetto 2010
Lavezzi 1	Corsica/Sardinia	25 AD-mid 1st AD	Amphorae, lead ingots, iron ingots, mixed ceramics	?	?	?	?	Boetto 2012: 164-65, Table 8.1
Lavezzi 3	Corsica/Sardinia	50-100 AD	Amphorae					Parker 1992: 240, n. 586
Ma'agan Mikhael B	Haifa	7th-9th AD	Misc.	19.6	4.9	3.5	150	Cohen and Cvikel 2019
Madrague de Giens	South France	1st BC	Amphorae, ceramics	40	9	3.5-3.7	350-390	Boetto 2010
Marseille 1	Marseille	2nd/3rd AD	Amphorae?	17	7			NAVIS
Perduto 1	Corsica/Sardinia	15-25 AD	Amphorae					Boetto 2012: 167-68
Port-Vendres I	Port Vendres	4th-5th AD	?	17.5	8	1.89	69	Boetto 2010
Prêtre B	Corsica/Sardinia	1st AD	Amphorae, iron ingots					Parker 1992: 67, n. 85-7
Spargi	Corsica/Sardinia	120-100 BC	Amphorae					Parker 1992: 409-11, N. 1108
St. Gervais 3	Saint Gervais	148-150 AD	Amphorae	17.54	7.4	2.36	81	Boetto 2010
Sud Lavezzi 5	Corsica/Sardinia	50-150 AD	Wheat? Italian sigillata, communal ceramics	30				Boetto 2012: 166, Table 8.3
Sud-Lavezzi 2	Corsica/Sardinia	22 BC - 5 AD	Amphorae, lead ingots, iron ingots	20	?	?	26	Boetto 2012: 164-65, Table 8.1
Sud-Lavezzi 3	Corsica/Sardinia	early 1st AD	Amphorae					Boetto 2012: 164-65, Table 8.1
Sud-Perduto 1	Corsica/Sardinia	25 BC-25 AD	Amphorae	?	?	?	50-70	Boetto 2012: 164-65, Table 8.1
Sud-Perduto 2	Corsica/Sardinia	1 AD-14 AD	Amphorae, lead ingots, iron ingots	?	?	?	26?	Boetto 2012: 164-65, Table 8.1
Tantura F	Dor	7th-8th	?	16	5	1.5	30	Barkai and Kahanov 2016

Table 9.1: A selection of Roman merchant shipwrecks throughout the Mediterranean; pre-Roman and Byzantine specimens also included for wider temporal considerations, accounting for use of the harbour of *Berytus* in earlier and later periods

Scholars sometimes utilise shipwreck data in conjunction with ancient texts that list cargo sizes and discuss maritime law to provide a comprehensive categorisation of merchant vessels throughout the Roman Empire. Specifically, Rathbone specifies ‘small’ ships as those holding less than 50 tonnes and dedicated to short distance cabotage, ‘medium’ for those carrying 60-80 tonnes, and up to 150, for ‘inter-provincial Mediterranean routes’, and ‘large’ for massive ships with a cargo of 200-400 tonnes, sometimes larger, for ‘routes with regular large-scale traffic’, based largely on Parker’s compilation (Rathbone 2003: 201). He then compares these figures to the standardised cargo sizes for the distribution of products destined for the *annona* (Rathbone 2003: 210-1). For example, the *Digest* is often cited as a reflection of the standardised cargo sizes: 65 tonnes for smaller vessels, which, if contracted for the distribution of products destined for the *annona*, granted the rights of citizens and Latins, and 330 tonnes for larger vessels, which gave exemption from public employment (*Dig*. 50.5.3, 50.6.6, 50.6.7). Reaching the 330 tonnes threshold was also possible by owning several ships, each of which had a capacity of at least 65 tonnes (*Dig*. 50.5.3). However, these specifications are only applicable to ships contracted by the state. At a number of port sites, particularly on the Levantine coast, these contracts may not have been as prevalent as those dedicated to the provision of grain from Alexandria, or olive oil from Spain or North Africa, to Rome (Keay 2010). While it is possible that *Berytus* served as an outlet for the export of grain from the Bekaa or the Hauran (Butcher 2003: 165, 168-9, 177; Elayi 2010: 163), any proposition tying *Berytus* to the *annona* remains conjectural at this time.

Other studies, such as that of Broekaert and Zuiderhoek, which provides a comprehensive assessment of investment in capital goods in the Roman period, are more dismissive of shipwreck evidence (Broekaert and Zuiderhoek 2020). Some, such as the one listed above, go as far as saying that any useable maritime archaeological data, which itself is fragmentary, is highly skewed due to the fact that larger ships are more visible in the archaeological record, and ‘smaller vessels operating in cabotage trade or shipping merchandise from estates to the harbour remain completely invisible’ (Broekaert and Zuiderhoek 2020: 110). This is a gross oversimplification of complex processes regarding site formation of underwater shipwrecks, as well as the ways in which archaeologists approach the examination and analysis of each site (Keith 2016; Martin 2013; O’Shea 2002: 225-6). As a result, their consideration of cargo capacity, crew size, annual wages, financial investment and funding, and various other maritime economic factors is based heavily on ancient texts.

This is unfortunate, given the promise of their approach and the significant contribution it can make to our understanding of maritime commerce in the Roman Empire. As a result, their subsequent analysis is focused primarily on comparative data from different time periods, and a single Alexandrian register of ships arriving in the harbour in the Roman period (*P. Bingen* 77; Broekaert and Zuiderhoek 2020: 110-1). However, their study is invaluable in that it also shifts focus to smaller vessels, and considers investment and finance independent from the criteria of ships dedicated to the distribution of products for the *annona*. Their research indicates that the participation in maritime commerce was not limited solely to the wealthier classes transporting large cargoes largely contracted by the State (Broekaert and Zuiderhoek 2020: 112). Rather, non-elite individuals might have been able to purchase or invest in smaller vessels (Broekaert and Zuiderhoek 2020: 124). This is a crucial re-examination because it indicates that, if the average vessel was indeed smaller than previously asserted, the average investor in maritime transportation was not necessarily an elite, wealthy Roman citizen (Broekaert and Zuiderhoek 2020: 124-5). Though they contextualise their argument within the Empire as a whole, this trend is reflected in the capacity of the harbour of *Berytus*, along with the other examined port sites in the Levant.

Beirut was probably able to receive Roman merchant ships with a cargo of roughly 70 tons or less in its urban harbour based on the available data (Chapter 5). The possible spacing of mooring stones in the installation of BEY 039 might also suggest the prevalence of smaller ships (under 5m in width), at least along this portion of the quay. In terms of draught, most sites included in this study seem to have been quite comparable to Beirut, apart from the outer basin of Caesarea, which would have been able to receive larger ships (Brandon 1996: 34; Raban 1989: 288), and presumably Seleucia Pieria and Antioch, but this is currently not confirmed by archaeological data. Thus, the majority of ships that likely frequented *Berytus*, as well as a number of other eastern Mediterranean sites, would essentially all be classified as small ships based on most archaeological classification systems, defined as weighing under 70 tons when fully-laden, and generally between 5-6m wide and 20-25m long (though this is highly variable and regional, as discussed throughout this section) (Boetto 2010; Rathbone 2003; Parker 1992).

Ultimately, the harbour of Roman Beirut was never on the scale of monumental ports such as Portus (6-8m deep; 2,330,000 m^2) (Keay 2020; Salomon et al. 2016) or Fréjus (7-8m deep; at least 120,000m^2) (Bony et al. 2011). In this way, it does not appear that the most massive ships, possibly related to the transportation of large cargoes of grain, olive oil or wine, would have been able to access the harbour, such as the Madrague de Giens or the Sud Lavezzi 5 ships (Boetto 2012: 166, Table 8.3; Tchernia et al. 1978; Wilson 2011b: 40). Rather, it is more likely that smaller ships, similar to that uncovered near Fig Tree Bay in Cyprus (Leidwanger 2013a), were prevalent at *Berytus*, and associated with private endeavours as opposed to large ships contracted by the state. This is also supported by the high likelihood that the Beirut Type packaged wine, as well as its sporadic distribution (Chapter 7; Woodworth 2011).

9.3.2 **Maritime Commercial Finance**

These propositions are also quite impactful in the subsequent discussion of the financing of maritime commerce (Arnaud 2007; Broekaert 2011; Scheidel 2011; 2013; Temin and Rathbone 2008). Specifically, scholars have summarised the investment schemes for the maritime transportation of a cargo in the Roman period into three formats. Either a ship owner transported cargo for another individual or institution, with no claim on the products whatsoever, or a ship owner also acted as a merchant, or some combination of both, in that the ship owner was purchasing and transporting their own personal product but also transporting cargo for another individual (Broekaert and Zuiderhoek 2020: 107-8, 127; Meyer-Termeer 1978; Rathbone 2003: 210; Sirks 1991). The funding of these voyages generally was provided through two main ways: by forming a *societas*, consisting of a joint partnership of a group of traders to share in investment and spread risk (Broekaert 2011: 228), or private investment in some capacity (Temin and Rathbone 2008). Scholars have generally leaned towards the prevalence of self-finance or finance through *societates* for larger cargoes (Broekaert 2011; Rougé 1966: 250-4, 423-4; 1980: 291-5, 298-300; 1985: 167-9), especially since it has been suggested that direct involvement in maritime commercial finance was not generally well-regarded, and usually avoided (De Salvo 1992: 225-37; Rathbone 2003: 203).

However, there are several issues with this position. Firstly, it must be recalled that this applies to the sentiments of wealthy Roman citizens and does not necessarily represent the mind-set of all individuals involved in maritime commerce (Rathbone 2003: 203). Furthermore, the actual involvement of wealthier individuals could be, and often was, actuated through agents (freedmen or slaves), and not directly by the elite (Aubert 1999; Rathbone 2003: 216; Tchernia 2007). This allowed a circumvention of possible restrictions and an avoidance of any possible negative connotations associated with participating in mercantile activities suggested by ancient writers (Broekaert and Zuiderhoek 2020: 125). Secondly, the fact that there was an actual formal introduction of a law that placed restrictions on ship ownership, with opposition from senators in the Republican period on the application of this law, suggests that the wealthy class was indeed involved in maritime commerce which necessitated the law to begin with (Broekaert and Zuiderhoek 2020: 124-6). Thirdly, as discussed in the previous section, even macro-oriented examinations stress the underestimation of the prevalence of smaller vessels in maritime commerce in the Roman Empire (Arnaud 2001-2002: Leidwanger 2011: 375-6; Parker 1992: 26).

For these reasons, this deductive approach cannot hope to capture the nuances regarding the financial management of shipping specifically through the port of *Berytus*. Regardless, these considerations are useful in distinguishing between the landowning or renting producers of wine in the colony, and merchants that facilitated its transportation throughout the Mediterranean (Kehoe 2007: 46). Furthermore, the frequent mention of these ties between the various agents (ship owners, merchants, captains, financial agents, producers, packagers, tax agents, etc.) indicates the relative familiarity and normality of these financial relationships (Broekaert 2012; MacMullen 1982; Tchernia 1986: 126-7). This is attested specifically for *Berytus* in the famous contract cited in the *Digest* dated to the 2nd century AD,

> 'Callimachus borrowed money from Stichus, the slave of Seius, in the province of Syria, for the purpose of being used in maritime trade from the city of Berytus to Brundisium. The loan was for the two hundred days required for the voyage, was secured by the pledge and hypothecation of merchandise purchased at Berytus, to be taken to Brundisium, and also included that which was to be purchased at Brundisium, and conveyed to Berytus; and it was agreed between the parties that when Callimachus arrived at Brundisium, he should depart from there by sea, before the next Ides of September, with the other merchandise which he had purchased and placed on board the ship; or if, before the time above mentioned, he did not purchase the merchandise or leave the said city, that he would immediately repay the entire amount, just as if the voyage had been completed; and that he would pay to those demanding the money all the expenses incurred in taking it to Rome; and Callimachus promised Stichus, the slave of Lucius Titius, as stipulator, to pay and perform all this faithfully.'
>
> **(Just. *Digest* 45.1.122)**

Two important points must be highlighted in this text: firstly, that Callimachus is the merchant and not the ship owner, with the cargo pledged as security. This characterisation further corroborates the differentiation between these two roles, and the significant value of a ship's cargo, especially for poorer merchants (Rathbone 2003: 211, 215-6). Secondly, the agreement was undertaken through an agent (Stichus), and though this characterisation is hazily made in the text, it indicates that there is some degree of intermediation (Bürge 1987: 519-27; Petrucci 1991: 206-26; 2002: 164-71; Verboven 2020: 412).

These observations are also attested in other ancient texts, though it must be admitted that they largely come from Egypt (Rathbone 2002; 2007). For this reason, I only list these works to further highlight the differentiation between various levels within maritime commercial infrastructure. Specifically, the texts also suggest that a ship owner should be differentiated from a merchant (though they could be one and the same in certain cases) (*SB XIV* 11850; Aubert 2016), and an investor might also be another independent party (Andreau 1987: 162; 1999: 17, 54; Broekaert 2011: 228; Rathbone 2003: 210-1; Temin and Rathbone 2008). Beyond this basic differentiation of actors, any further characterisation is currently the subject of debate (Andreau 1999: 50-63; Millet 1991: 218-21) and outside the scope of this thesis.

9.3.3 **A Differentiation Between Supplier and Distributor**

I argue, therefore, that it might have been possible for a producer of *Berytus* wine to have been differentiated from the merchant transporting the packaged amphorae. This differentiation is crucial in breaking down generalisations regarding 'centralised' or 'market-centred' economic trends into more accurate and appropriate characterisations of viticulture and oleiculture in *Berytus*. In other words, the administrational organisation of viticulture and oleiculture within the colony in terms of land ownership and regulation is not necessarily related to maritime commerce undertaken at the urban port centre. Whether the producer was a veteran, private citizen, a lessee of the municipality, or the municipality itself, there is no reason to believe that the fermentation of wine at an estate in the Mount Lebanon Range or the Bekaa is directly tied to the ship that transported it to another port site for subsequent consumption. While it is possible that the initial producer might have managed every step along the supply chain till final distribution, this is highly unlikely for the reasons listed above. Therefore, the simplification of each individual step in the supply chain into one comprehensive label does not further our understanding of economic patterns. Rather, based on the data presented in this thesis, it seems that examinations should be inductive as opposed to beginning with pre-existing assumptions regarding Empire-wide trends, and seeing where a specific port site fits into this categorisation.

9.4 **Preliminary Considerations of Causality**

Regardless of these considerations, the question remains, that if the wines of *Berytus*, as with other Roman sites in Lebanon, were so well-regarded (Pliny *HN* 14.74-75; Harfouche 2014: 158), why is this not apparent in the archaeological record? The regional market of *Berytus*, when compared to the wider Mediterranean, appears to have been quite limited in terms of wine and possibly other agricultural products. It never reached the capacity associated with maritime commercial routes between North Africa and Gaul or Italy (Hobson 2012; Keay 2010: 17; Mattingly 1988b), Spain and Italy (Rice 2011: 84; 2016), Cilicia/Asia Minor and Cyprus with a variety of sites throughout the Mediterranean (García Vargas 2011: 78; Hodges et al. 2005: 241; Piéri 2005: 74), or the southern Levant with the eastern Mediterranean (Piéri 2005; Reynolds

2005). Why was wine packaged in the Beirut Type never exported in a similar volume as observed in each of these other regions (Butcher 2003: 401)?

One of the limiting factors might have been related to the natural topography, characterised by a narrow coastal plain at Beirut and no navigable rivers (at least in any significant capacity) along the western slopes of the Mount Lebanon Range. At a number of regions throughout the Empire, fluvial networks appear to have been quite prevalent in the production and distribution of agricultural goods packaged in amphorae (Campbell 2012: 200-3). In North Africa and Spain, for example, kiln sites are situated in close correlation with river systems (Figure 9.2 and Figure 9.3). In Gaul, the distribution of Dressel 1 amphorae also seems to be quite closely correlated with rivers, also corroborated by the uncovering of tens of thousands of amphorae from shipwrecks in fluvial contexts (Pomey and Boetto 2019: 8). Beirut, on the other hand did not enjoy the benefit of easily navigable rivers or wide plains near the coast. Rather, the coastal plain ends abruptly, giving way to the Mount Lebanon Range. Thus, it is possible that the lack of a conducive fluvial network hindered the colony's capacity for growth since it prevented efficient transportation. This is supported by the lack of correlation between the distribution of presses (6.3) and kiln sites (6.4.2) in the study region.

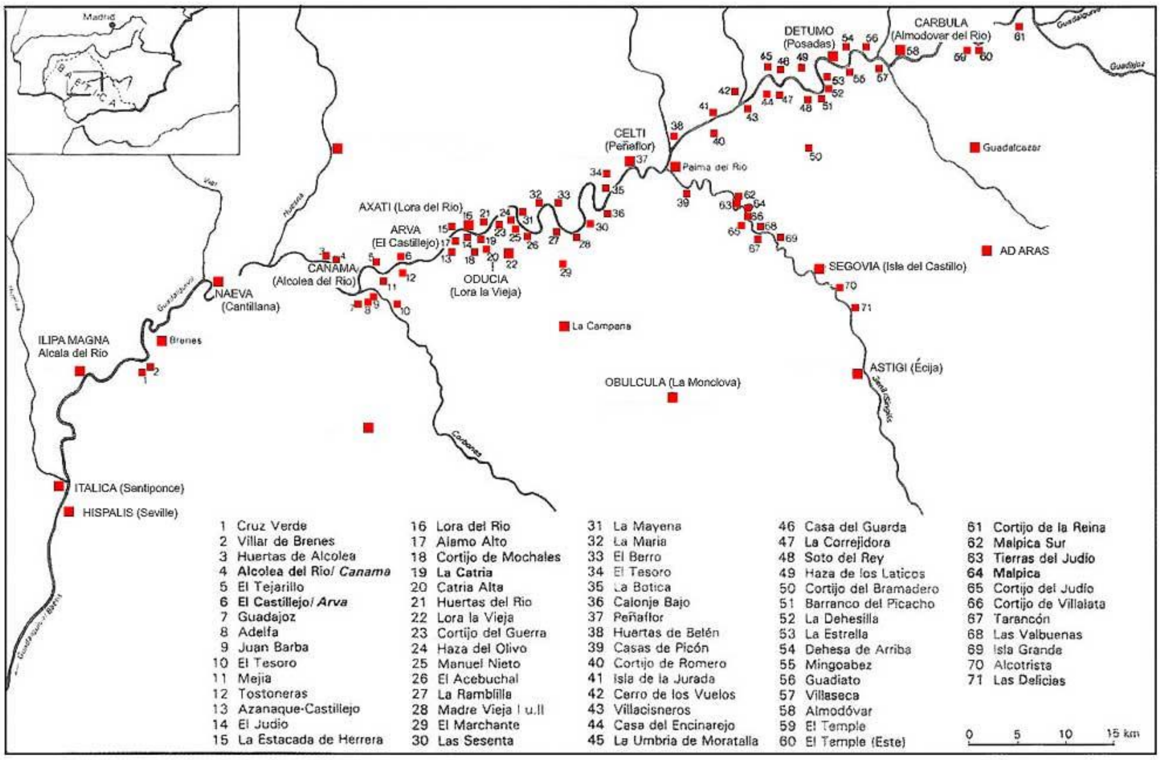

Figure 9.2: The distribution of kiln sites in the Lower Guadalquivir Valley (after Keay and Williams 2014)

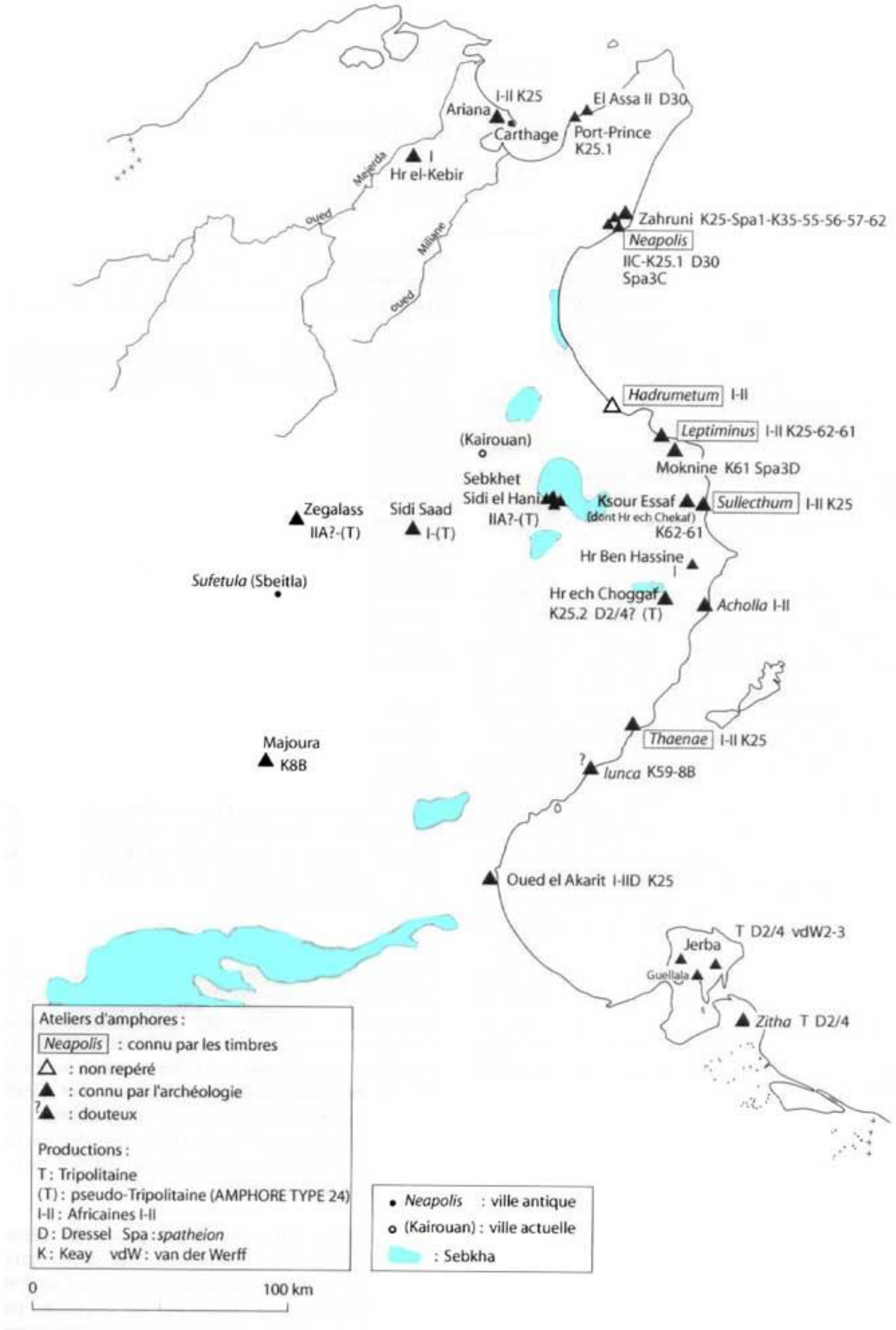

Figure 9.3: The distribution of kiln sites in North Africa (after Keay and Williams 2014)

Another consideration is the recurring problem of the Ituraean 'bandits' that dwelled in the Mount Lebanon Range east of Beirut (Jones 1931). The establishment of sites such as *Borama* and *Balmarcodes* in the Mount Lebanon Range en route to the Bekaa were likely some measures taken to establish a foothold in the region, but it does not appear that this group was ever fully subdued in the Imperial period (Hall 2001-2002: 142). Thus, the lack of political uniformity may have hindered collaboration and communication between workshops and agricultural producers, resulting in more regional, nucleated pockets as opposed to the commonly-cited villa system of Spain and North Africa (Reynolds 1999: 50).

This is not to diminish the capacity of production of the colony, especially considering the vast quantities of Beirut Type amphorae uncovered at the urban centre. With an estimated population of 50,000 (Wilson 2011a: 187), *Berytus*, which had previously been a smaller Phoenician city relative to the rest of the Levantine coast, became a comparatively large city in Roman Syria (Butcher 2003: 112). This population increase must have been associated with the settlement of veterans within the urban centre (Perring et al. 2003: 204). It is also attested in the significant increase in the quantity of amphorae found at the city (Reynolds 1999: 51, Table 1), which suggests that a higher volume of wine and possibly olive oil was being consumed at the city. But the subsequent exportation of this product never manifested in the same way as other networks around the Mediterranean.

9.5 Economic Considerations

How, then, does *Berytus* fit the narrative proposed by NIE followers, specifically that 'universal peace…predictable demand…and imperial stabilisation' led to economic development throughout the Empire (Scheidel 2011: 36-37)? Furthermore, does the incorporation of legal and political institutions in economic analyses help shed light on causative factors in colonies' development (Elliott 2020: 11)? These are important questions in the archaeological analysis of regional markets and in site-specific studies that, in the past, have generally been asked based on a deductive approach regarding macro-economic patterns (Broekaert 2012; Hopkins 1980, 2002; Macmullen 1982; Scheidel 2009; 2011). While this approach is useful in revealing Empire-wide connections and economic developments in the *longue durée*, it is problematic working in reverse, and attempting to apply the same conclusions to specific sites throughout the Mediterranean. For example, scholars often cite economic crises in the Roman Empire, and strive to explain the causes of periods of stagnation and depression along with responses enacted by authorities to assuage the financial predicaments (Rathbone 2005: 262; Wassink 1991: 473). The resulting focus of scholars is geared to either diminishing the relevance of these crises and the awareness of the mechanisms that effected change, or suggest an active participation in the shaping of a Mediterranean-wide economy (Koops 2016). But a more relevant question seems to be what effect, truly, did these institutional-related factors have on provincial towns and cities around the Empire, and specifically in Roman Syria? The commonly-discussed economic crisis of

33 AD (Tac. *Ann.* 6.16-17; Dio Cass. 58.21.4-5; Koops 2016), does not appear to have been prevalent in Beirut. At this time, the city was undergoing significant urban and rural expansion and establishing new commercial routes, as well as expanding production centres of amphorae to several other sites along the coast. In the hinterland, improved wine and olive oil presses began to be utilised, most prevalently in the Bekaa. Harbour installations were renovated and the basin was dredged, possibly indicating an increase in traffic. These factors actually point to a significant degree of intensive and extensive economic growth rather than crisis and decline. Similarly, the city's period of stagnation in its wine industry is more closely associated with the independence of Baalbek as opposed to any macro-economic decline.

Rather, the implementation of NIE on a regional scale is useful in micro-examinations as well. The settlement of veterans at *Berytus* can be interpreted as a change in the 'rules of the game' (Kessler and Temin 2007: 321), an exogenous factor introduced to the Hellenistic City of Beirut (Basu et al. 1987: 3). Similarly, Severus's separation of Baalbek from *Berytus* and granting of *ius italicum* to its settlers (Perring et al. 2003: 212-4), as well as an elevation of status at Arca, Tyre and Sidon, where groups of veterans were settled (Dąbrowa 2012: 33), clearly disrupted the production and distribution networks of Roman Beirut, as attested by the sudden drop in exports after the Beirut Type 3 went out of production. These developments did not occur based on economic rationale, yet they effected serious change within the economy of the colony.

In this way, NIE can serve to form the link between political developments and economic consequences, and transition current discussions from studying each independently to assessing a site comprehensively (Williamson 2000: 595, 601). Though previous scholarship has focused this on the *longue durée*, such examinations might be more appropriate on a smaller scale, and clearly are applicable inductively. I have attempted to show this in the examination of Roman Beirut not solely based on economic capacity, frequency of exports, or maritime traffic, but through a comprehensive assessment of socio-political, environmental and commercial trends. Before debating the root of economic growth (Scheidel 2009; Wilson 2009), or the level of integration of the Roman Empire (Woolf 1992), or the very nature of economic rationale in individuals (Rathbone 2005), perhaps we should be thinking more about the method in our approach.

To be clear, I am not refuting the primary point of NIE followers that under the unified Roman Empire, a conducive environment was created for economic stability and growth, and that certain commonalities can be drawn across a cohesive Mediterranean (Lo Cascio 2006: 221). But conclusions must be carefully clarified, especially in terms of the correlated variables for economic expansion. Furthermore, as I have argued in this thesis, analyses must start at a regional scale before extrapolating results. The application of a deductive methodology regarding the Roman Empire as a unified economic system cannot hope to capture the nuances of a single port city. The contrast observed between *Berytus* and the Roman Empire as a whole in terms of the ebb and flow of economic patterns, as well as the uniqueness of the colony in Roman Syria, are evidence of this.

Chapter 10 **Conclusion**

In this thesis, I have attempted to suggest an appropriate approach to the understanding of Roman port cities throughout the Mediterranean that marries environmental considerations (Chapter 3), archaeological data (Chapter 5, Chapter 6, and Chapter 7), network analysis (Chapter 8) and economic theory (Chapter 9). Each specific methodological focus is not novel in itself; rather, the sum of these analyses allows for a new way to characterise a Roman port city not singularly as a distribution hub (Rice 2016), marketplace (Erdkamp 2005: 182; Rathbone 2003: 225), or strategic transit point (Bekker-Nielsen 2013: 12), but as the sum of all of these identities. Most importantly, the study has shown the merits of an inductive approach, specifically in the application of economic theory on a regional scale as opposed to a focus on macro-economic trends in the *longue durée*. This is particularly valuable with regards to NIE, which, until now, has been utilised to assess the Roman Empire as a whole (Scheidel 2011).

Returning to the research questions presented in the introduction, several conclusions can be proposed. Firstly, regarding the ecological character of Beirut and its environs, there seems to be a significant degree of correlation between economic trends and environmental considerations. In terms of rural settlement in the hinterland, the current state of research does not allow a full analysis of the density of sites around the least-cost route from Beirut to the Bekaa south of Nahr Beirut (6.2). However, the milestones marking a possible road from Beirut to Baalbek do indeed follow the least-cost route (Chapter 6) (Abou Diwan and Doumit 2017). Furthermore, the northern distribution of sites, starting with Deir el Kalaa, does seem to follow the topography of the Mount Lebanon Range east of Beirut. Trends in the distribution of production sites suggest a higher degree of specialisation in viticulture and oleiculture in the mountainous regions of Lebanon characterised by lower temperatures and higher precipitation, with the Bekaa possibly dedicated to the agriculture of crops that require long, open fields and more fertile soil (6.3.3). Moreover, no crushers were uncovered in the Bekaa, indicating that most installations might be related to the production of wine. Of course, these data could be biased due to gaps in fieldwork in the Bekaa, and perhaps future work could shed further light on the matter. Thus, although Beirut does fall within the criteria of what defines a 'Mediterranean climate' (Habib and Waad 2007), a closer look at its micro-ecology, and a consideration of the narrow coastal plain characterised by sporadic rivers and a sharp rise in elevation, sheds light on important settlement patterns and networks.

The next inquiries posed in the introduction pertain to the port city, specifically regarding the development of the urban centre and the harbour. Based on the data presented in Chapter 5, *Berytus* seems to be a large port city on the regional scale, but never reached the size or capacity of monumental port cities such as Carthage or Ephesus. Most merchant ships, apart from massive vessels with draughts deeper than 2.5-3m, were able to access the harbour quite consistently, similar to most other sites assessed in this study. The evidence suggests that previous harbour installations erected in the Iron Age and refurbished in the Hellenistic period were reutilised in the Roman period (5.2.3.1). The new city plan, though it involved the implementation of a new urban grid in certain quarters, preserved the existing harbour and its surrounding area. This indicates a prioritisation of maintaining consistent access to the harbour, especially during intense periods of construction in the city, confirming the importance of *Berytus*'s maritime character in the Roman period.

This does not seem to be related in any significant capacity to the export of wine and, to a lesser extent, olive oil from the port. As observed in Chapter 7 and Chapter 8, the distribution of the Beirut Type never represents more than 5% of any assemblage assessed from coastal sites in the Levant and Cyprus. Conversely, the type represents the vast majority of specimens uncovered from the city of Beirut (Reynolds 1999). This indicates that it was clearly the primary container used for the packaging of wine and possibly olive oil in the colony, and that the market within the city itself largely sufficed as a market for producers in the hinterland. Based on these trends, as has been argued in Chapter 8 and Chapter 9, *Berytus* wine might have been more commonly transported as a secondary part of a ship's cargo, and characterised as more of a luxury product. Indeed, Pliny's praise of the quality of the wine supports this conclusion (Pliny *NH* 14.9.7).

The distribution patterns indicate a fairly consistent connection between Roman Beirut and Cyprus, which seems to follow the maritime routes suggested by wind speed/directionality and currents (Blue 1995: 6.2.3, Route C). They also seem to be correlated with previous commercial ties prevalent in the Hellenistic period (Ala Eddine 2003; Aubert 2003). In this way, there appears to be a significant degree of fluidity in commercial routes in the transition from a Hellenistic city to a Roman colony. Similar to the adoption and reutilisation of the existing harbour, the population of *Berytus* did not deviate drastically from the existing prevalent commercial patterns.

Finally, what do these patterns suggest regarding the socio-economic and socio-political characterisation of *Berytus*? First and foremost, Baalbek should be included conclusively within the territorial extent of *Berytus*, and regarded as a distinct colony starting in 193 AD (Millar 1993: 218, 221). The urban stagnation at Roman Beirut as well as the complete disappearance in the export of wine packaged in the Beirut Type after the 2nd century AD are evidence of this. They also indicate that the population living in Baalbek composed a major percentage of producers that supplied the city of *Berytus*. Secondly, the settlement of veterans at the city sparked significant economic developments, which can be primarily characterised as extensive growth. In this way, it seems reasonable to propose that a large quantity of the wine being packaged in Beirut Type amphorae must have been produced on veteran-owned lands, or commissioned by veterans or one of their agents in some capacity. However, colonisation and settlement did not result in any overhaul of the existing maritime commercial patterns, or the construction of any new harbour as observed in Caesarea. Thirdly, these developments cannot be wholly labelled as either 'public' or 'private in nature. The sporadic distribution of exports, the existence of multiple workshops and the distribution of oil and wine presses in the region all point to a complex administrational organisation of viticulture and oleiculture that cannot be summarised in such a simplistic dichotomy (9.2 and 9.3). Though it is tempting to cite the stamping of the Beirut Type 2 amphora as corroboration of central control, each step in the supply chain must be regarded independently for an accurate examination.

Furthermore, by incorporating environmental considerations, which contextualise archaeological data reflective of agriculture (Rubio-Campillo et al. 2018; Waliszewski 2014) and allow for least-cost route analysis, this thesis has also introduced a new possible element of causality beyond the scope of NIE. In other words, perhaps the environment in itself can be considered another institution in the model, as an endogenous factor affecting economic trends. This has been touched on previously (Scheidel 2010: 9-11), but arguably not on the appropriate scale, nor in a way that truly addresses incentive structures. The relationship between sites in the Bekaa, the Mount Lebanon Range and Roman Beirut are evidence of this.

10.1 Shortcomings in the Data

This work has also highlighted several areas that require further research. Firstly, there is a need for clarification regarding ware analysis to differentiate Beirut products from Jiyeh or Khalde products, as well as definitively associate a workshop with the production of Types 4-8. Gemmayze, for example, seems to have been a production area of glass, ceramics, and various other objects in Roman Beirut (section 6.4.2.1), and could clarify some of the confusion regarding the production of Beirut Types 4-8, the 'carrot-type' amphora, and the AM 72 form. Unfortunately, to my knowledge, excavations in Gemmayze have resulted in just one publication regarding the numismatic data (Sawaya 2016).

Secondly, there is a significant lack of fieldwork and publication in the region east of Beirut and generally across the Mount Lebanon Range. This is most apparent around the least-cost route south of Nahr Beirut. No formal archaeological survey has yet been conducted in the region, and, based on this thesis, it represents an area of high archaeological potential. Given the promise in

Khalil's recent work (2009; 2015), it would be interesting to assess the pattern of rural settlement along what must have been the primary route connecting the urban centre of *Berytus* to the Bekaa. This is also the case regarding the sites along the northern face of Nahr Beirut near Deir el Kalaa and Brummana. Such a strategy could also be employed for the hinterlands of some of the northern maritime sites such as Jounieh, Byblos, Batroun and Tripoli.

Thirdly, ceramic reports in Lebanon are lacking, though recent work has seen a significant improvement in this regard (Hamel 2014; Reynolds et al. 2010; Wicenciak 2016a; 2016b). However, this is a definite need for quantified assemblages from defined contexts to allow for the assessment of distribution networks. While I was able to extract quantifiable data from numerous port sites throughout the eastern Mediterranean, this was only possible at Beirut, Tyre and Ain Ikrine in Lebanon, with Ain Ikrine only providing a small, preliminary sample taken from a survey (Fares 2010), and Tyre lacking quantified data (Gatier 2011; Gatier et al. 2011). If economic trends are to be proposed that go beyond the simple presence or absence of a connection, and move towards considerations of the strength and nature of connections, this will require a database of frequencies. Obviously, much archaeological work in Lebanon in the past has been largely rescue excavation, or preliminary survey, which makes such analyses difficult (Wicenciak 2016a: 648).

Lastly, results from recent excavations in Beirut must be published urgently, as the region surrounding the Souks area remains poorly understood. The wider coastal plain holds important archaeological insights regarding settlement patterns in the immediate environs of the urban centre, and would provide some much-needed clarification regarding the relationship between urban dwellings and possible agricultural sites. This is highlighted by the possibility that Roman villas might have once dotted the coastal plain in the Late Roman period (6.2). These discussions are not meant as criticism of previous work in any way, as the past several decades have seen immeasurable progress in the archaeological examination of sites across Lebanon. They simply serve to highlight gaps in the data based on a thorough review of published material in the hope that these shortcomings might be addressed in the future. One of the ways to address these issues practically is, again, by prioritising the processing of unpublished material, particularly that of the important Roman sites of Sidon, Tyre, Khalde, Beirut and Byblos.

10.2 **Topics for Future Research**

This thesis has focused primarily on establishing a reliable methodology that could be applied to other port cities in the Levant in assessing economic patterns. In this way, perhaps the exciting and attractive macro-economic questions involving port cities might be addressed more appropriately. Specifically, with a consistent and methodical approach that allows for the cross-comparison of port cities as well as port systems, similar to that embodied by the Portus Limen project (Keay 2019), using the methodology suggested in this thesis could inductively build more accurate and applicable economic models that describe ancient societies.

However, given the wide range of topics incorporated in this analysis, there are a number of questions that remain unanswered. The primary one pertains to satellite maritime sites related to the colony of *Berytus*, perhaps not immediately visible in the archaeological record. Specifically, what is the frequency of the Beirut Type at these 'opportunistic' spaces (Leidwanger 2013d)? As discussed in Chapter 4, the prioritisation of a comparable set of port sites makes the incorporation of 'smaller' sites troublesome. Thus, there is a need to shed light on other possible anchorages in the immediate vicinity of the promontory of Beirut, as well as those across the central Levantine coast as a whole. These considerations are crucial particularly in the examination of administrational organisation of production. Specifically, these sites might represent 'something other than a subsidiary level of the same networks that linked the larger urban coastal hubs' (Leidwanger 2014: 37). Thus, the presence of the Beirut Type at any of these sites would be indicative of the prevalence of incentives and economic actors on a regional scale that might differ from those proposed for Mediterranean-wide networks.

Given the results of section 8.1.1.1, where geographical distance was determined not to have been a factor in the distribution of the Beirut Type, future work might prioritise different independent variables. The next step could be undertaken by embodying a systematic, GIS-based approach for the maritime environment of Beirut to shed light on maritime routes suggested by wind patterns, currents and harbour accessibility in the eastern Mediterranean. Leidwanger and Safadi's recent works might provide effective templates for the methodology required in transforming meteorological data and estimates for sailing speed into cost surfaces and backlink rasters (Leidwanger 2013c; Safadi 2016; Safadi and Sturt 2019; Whitewright 2007; 2016). This data could then be compared to any type of quantified distribution of archaeological material.

To address the gaps in the archaeological record in the hinterland east of Beirut, it would also be useful to conduct surveys along the least-cost route proposed in this thesis and elsewhere (Abou Diwan and Doumit 2017), as well as along the northern face of the river gorge of Nahr Beirut. Currently our understanding of the extent of rural settlements is lacking, particularly in providing deeper analysis for the often-mentioned monumental religious sites such as those at Niha, Sannine or Faqra (Newson 2019). This thesis has served to summarise and analyse the available data, but clearly there is a need for more fieldwork.

10.3 Closing Remarks

To end this discussion, I return to the broader questions regarding NIE and its inherent assumptions. In Chapter 2, I discussed the two main defining aspects of NIE that differentiate the approach from Classical and Keynesian economics: firstly, that the assumption of economic rationale is not inherent, and secondly, that the dimension of time must be considered in the formation of macro-economic models, and not incorporated as another variable with which to measure economically rational short-term decisions (North 1996: 344). The former assumption is a critical introduction, as it changes our perception of how and why decisions were made in the past. However, it seems that most current discussions continue to maintain an assumption that humans living in the Roman period did act rationally, but simply were restricted by institutions. This is summed up in Lo Cascio's contention that 'the individual cannot make a perfectly rational choice in the sense of wealth maximisation, since the information he has is imperfect and cannot give him the ability to decipher the reality around him and since his models for understanding this reality are imperfect as well' (Lo Cascio 2006: 219). This theory is also proposed by others in the sense that institutions served to form the 'rules of the game' within which economic actors functioned (Kehoe 2007: 29-30; Scheidel 2008: 12-3; 2010: 8). Based on this literature, it appears that there is a glaring confusion of a change in the formation of an individual's economic incentive with simply the incorporation of more factors that influence an actor's choice. In other words, scholars seem to be claiming that individuals were not acting according to economic rationale because of institutions influencing the legal and administrative structure of economy, but subsequently assuming that individuals are maximising their profit or utility based on these changes in the structure (Hopkins 2002: 11). In this way, the assumption of economic rationale has not been eliminated, and the only change in the methodological approach involves a comprehensive analysis of economic processes in conjunction with socio-political ones.

This is not to discredit the merit in the use of NIE, but that perhaps there is room for clarification in the approach. Specifically, I would argue that there has not yet been any research that truly challenges the assumption of economic rationale. This is not related to the dichotomy of modernism or primitivism, as supporters of each approach ultimately assumed that people *wanted* to act rationally, but the latter suggested that they could not, or did not based on exogenous factors (Finley 1973: 142; Garnsey and Saller 2014: 43). This also does not necessarily predicate on the merits and downfalls involved in using modern economic indices to study the ancient economy (Hobson 2014). Rather, I suggest that we have yet to incorporate any truly innovative considerations regarding the *formation* of incentives of various actors within production and distribution networks in the Roman period.

Similarly, however, we must also be realistic about the limitations involved in studying ancient economies through a fragmentary archaeological record. For this reason, I have attempted some preliminary strategies in understanding the incentives of producers of wine in the colony of *Berytus* and merchants transporting the Beirut Type, but do not presume to definitively conclude causation. Rather, this work has shown the value in prioritising correlative processes to clarify patterns. Ultimately, any number of conclusions can be reached when assessing the intricate web of regional micro-networks known as the Roman Economy in modern literature, as attested in the wide range of theoretical positions that exist today and the vehemence with which scholars defend them. In examining *Berytus*, I elected to begin on the smallest possible scale, and propose preliminary suggestions regarding the manifestation of production and distribution networks in the archaeological record. In this way, I hope that this characterisation of one port city in the Roman Mediterranean may be furthered through its contextualisation within the larger discussion, not as confirmation or refutation of the prevalence of economic rationale, but rather, through the introduction of new correlative variables.

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Appendix A Climate and Ecology of the Levant

A.1 Precipitation and Temperature

Precipitation levels and average temperatures in Lebanon are notoriously difficult to estimate due to a fragmentary meteorological database. Due to political turmoil, only four meteorological stations were consistently open before 2001, namely, those at Tripoli, Beirut International Airport, El Arez and Rayak (Merheb 2015: 78). Thus, various techniques are often implemented to better estimate precipitation levels throughout the country, as seen in the Tropical Rain Measurement Mission, which utilises satellite and radar technology to create precipitation maps in areas with incomplete data (Jomaa et al. 2019). As these methods often end in inconsistent results (Jomaa et al. 2019: 377-8), the author has prioritised station readings.

Meteorological data was acquired from Harris et al. (2014), which has been updated in recent years. These statistics were organised in Excel based on location, year and month, and input into ArcGIS to create a grid with average rainfall readings in 0.5° x 0.5° (longitude and latitude) squares throughout northern Egypt, the Levant, Syria and the south-eastern coast of Turkey. In order to graphically depict the spatial variation in rainfall, the Inverse Distance Weighted (IDW) tool was applied to the grid. This assigns values to cells based on a linear function, a combination of the set of meteorological stations used in the study. However, it must be stated that these maps should only be taken as broad estimates and not utilised in examinations of micro regions for several reasons. Firstly, the grids are based on average values acquired from all satellites within the respective area. Thus, when looking at the region as a whole, the figures will be accurate at the 0.5° x 0.5° scale, but will vary on a smaller scale. Secondly, the figures presented here do not incorporate elevation as a factor in determining variation in rainfall between stations. Humidity, cloud cover, and wind speeds are also not considered in the following maps. As a result, the readings adjacent to chosen weather stations will undoubtedly be quite accurate, but the IDW image is based solely on geographical distance from origin points. More detailed meteorological examinations are outside the scope of this section, and are addressed in other specialised publications (Jomhaa et al. 2019; Merheb 2015).

Results for Lebanon do not take into account weather stations in the Mount Lebanon and Anti-Lebanon ranges, and appear to overestimate Tyre's precipitation levels. Given that one of the primary purposes of this chapter is to better understand Beirut and its environs, more precision is required for the region surrounding Beirut. Thus, for the micro-examination of Lebanon, the author has utilised station readings from the American University of Beirut (AUB) weather station, as well as those from Bikfaya, El Arez, Ksara, Hermel, Nabatieh, and Tripoli taken from 1966 to 1969 from the Lebanese Monthly Bulletin for Climate Data. Although the readings are quite high from this time period, hovering around 100-200 mm above usual averages roughly between 1901 and 2018, the chosen stations from 1966-1969 provide reliable data to differentiate between regions of high, moderate and low levels of precipitation.

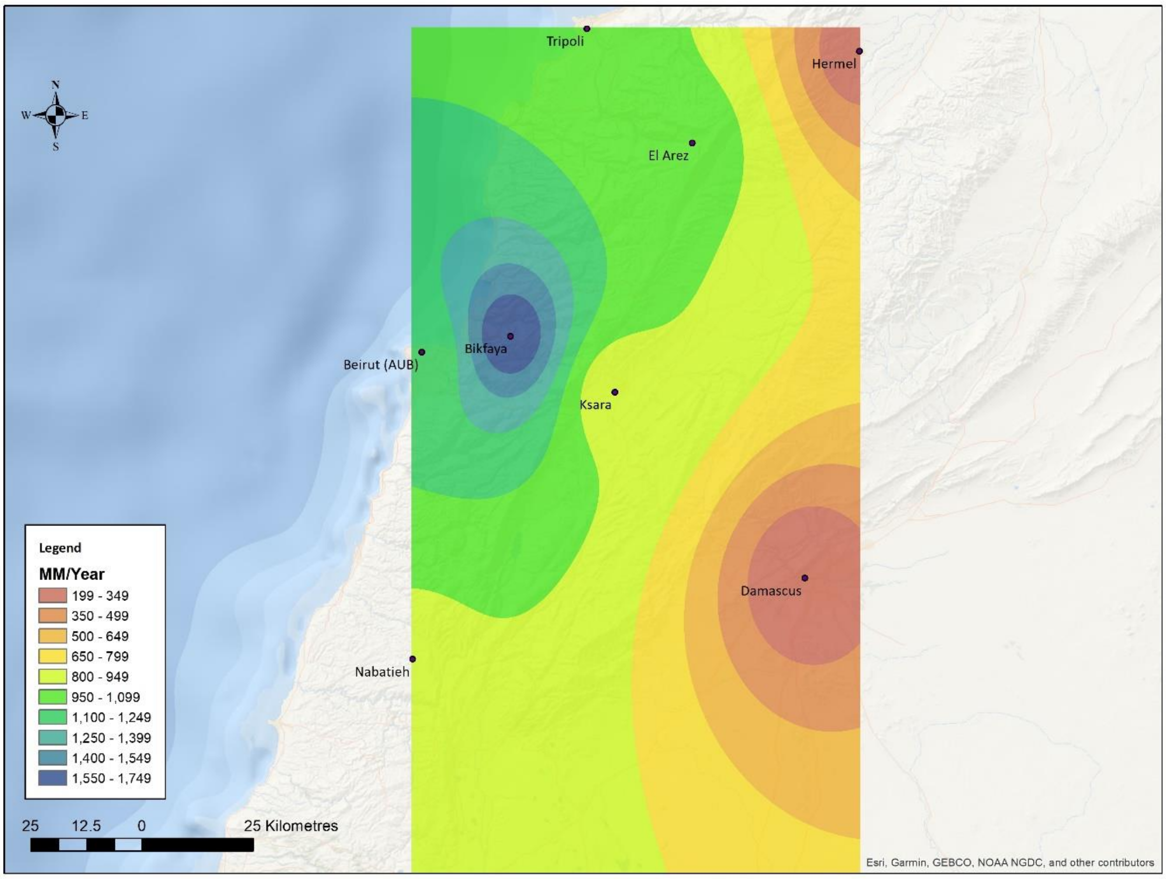


Figure A.1: Average yearly precipitation in the central Levant from 1966-1969 using 7 weather stations in Lebanon, one from the southern Levant and one in Damascus

Several patterns emerge regarding precipitation levels in the eastern Mediterranean as a whole. Firstly, rainfall is highest around coastal areas, specifically within roughly 50 km of the coastline (except for eastern Turkey towards Armenia, though this area is arguably at the outskirts of the Roman Near East). Inland, precipitation levels drop drastically. This is observed in Egypt moving south, the Levantine coast moving east, and the coast of Asia Minor moving north and northeast. On the Levantine coast, between the Mediterranean and the Mount Lebanon Range and Syrian Coastal Mountain Range, precipitation levels vary between 500 and 900 mm/year, with particularly high levels in the central Levant and south-eastern Turkey.

In Lebanon, there appear to be two peaks: one around the mountains of Bikfaya in the central part of the Mount Lebanon Range, and one in the northern mountains at El Arez. It must be stated that a large portion of this precipitation descends as snow, as the areas serve as popular ski resorts today. The areas of highest rainfall are located in between Bikfaya and Beirut, and between El Arez and Tripoli. These regions are situated at elevations ranging between 400 and 1000 metres above sea level and are characterised by rainy winters with rare snowfall at higher elevations.

As one moves towards the Bekaa Valley (Ksara and Hermel) and inland Syria, precipitation levels drop. The southern and central Bekaa Valley remains quite fertile and well-watered, with rainfall remaining at around 650-850 mm/year, but the north-eastern portion near Hermel is consistently dry, with levels rarely exceeding 250 mm/year, largely due to the high peaks of the northern Mount Lebanon Range blocking rain clouds from arriving from the Mediterranean coast (Jomaa et al. 2019: 371). This area leads into the Limestone Massif of Syria, where precipitation is about 300-400 mm/year.

In the southern Levant, it appears that the pattern of higher precipitation levels near the coast remains consistent. The coastal region around Caesarea, Akko and Jaffa receives between 500-600 mm/year, with levels dropping further south near Ashkelon. In the south-eastern region, east of Ashkelon and Jaffa, the area becomes arid and dry. This trend continues towards modern-day Jordan, where rainfall remains between 100 and 300 mm/year, and certain parts can be considered a desert (7 mm/year precipitation).

The eastern Mediterranean region largely follows patterns observed throughout the rest of the Mediterranean, with relatively mild winters and warm, humid summers and, as such, is characterised by a somewhat consistent ecology. Precipitation levels vary drastically between seasons, as observed below. Winters in the coastal region of the Levant are characterised by frequent rains and dry summers. As discussed earlier, precipitation levels drop drastically inland regardless of the season. Almost universally across Egypt, Cyprus, the Levant and coastal Syria, rainfall is generally below 20 mm in the months of June, July and August.

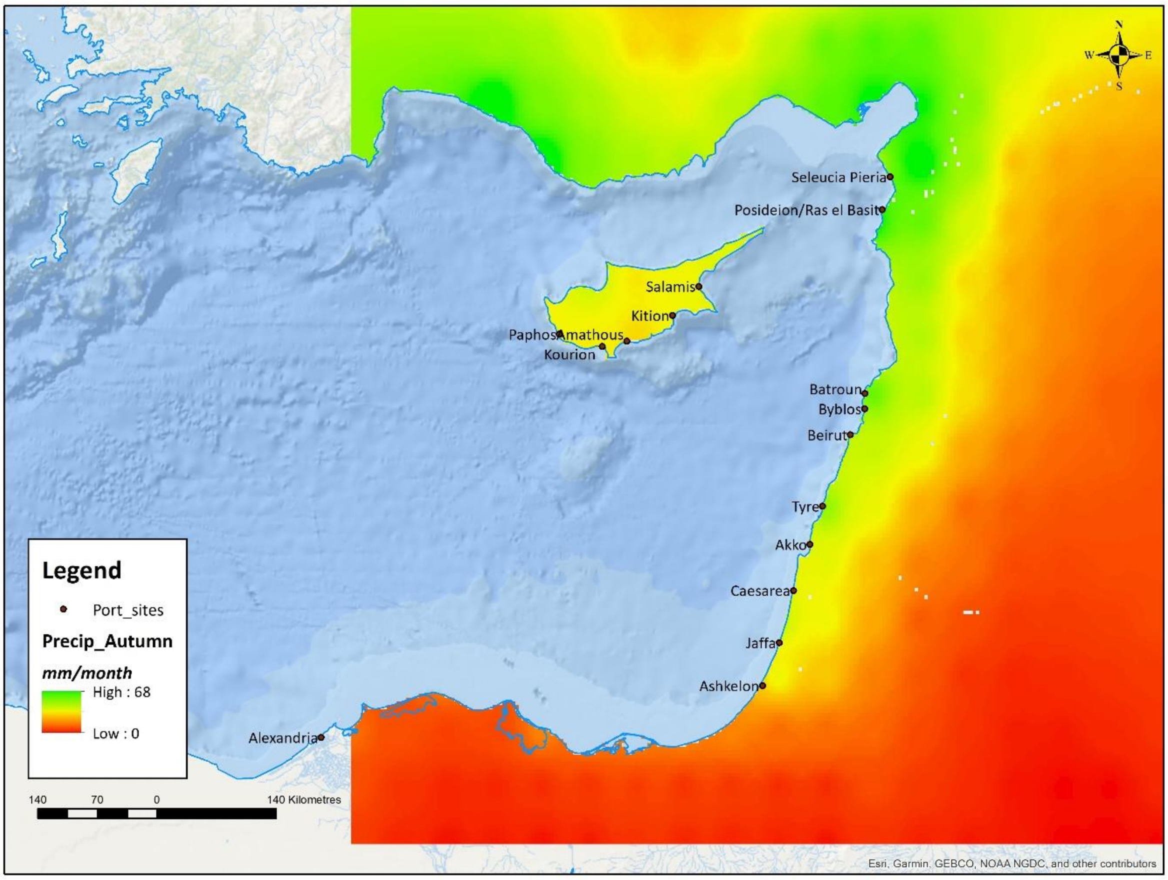


Figure A.2: Precipitation levels in Autumn – months 9, 10, 11 (data acquired from Harris et al. 2014)

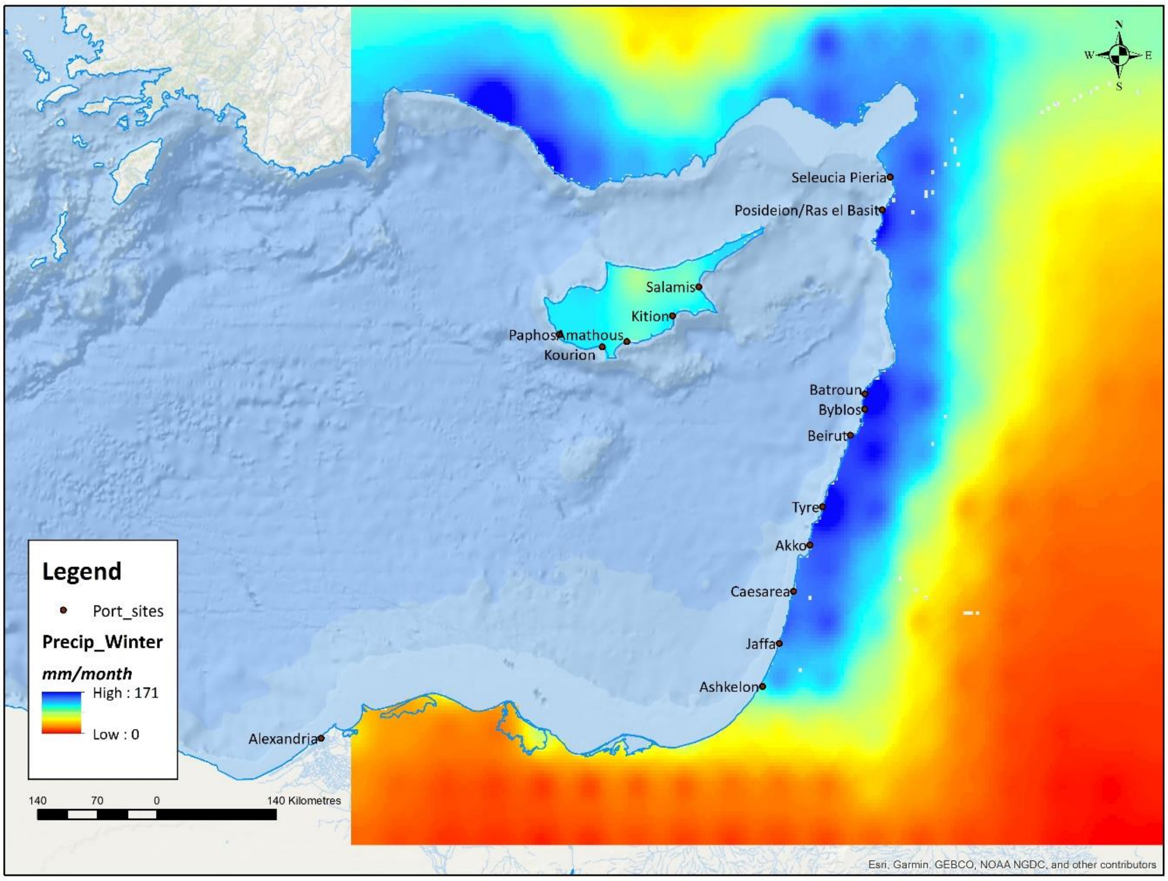


Figure A.3: Precipitation levels in Winter – months 12, 1, 2 (data acquired from Harris et al. 2014)

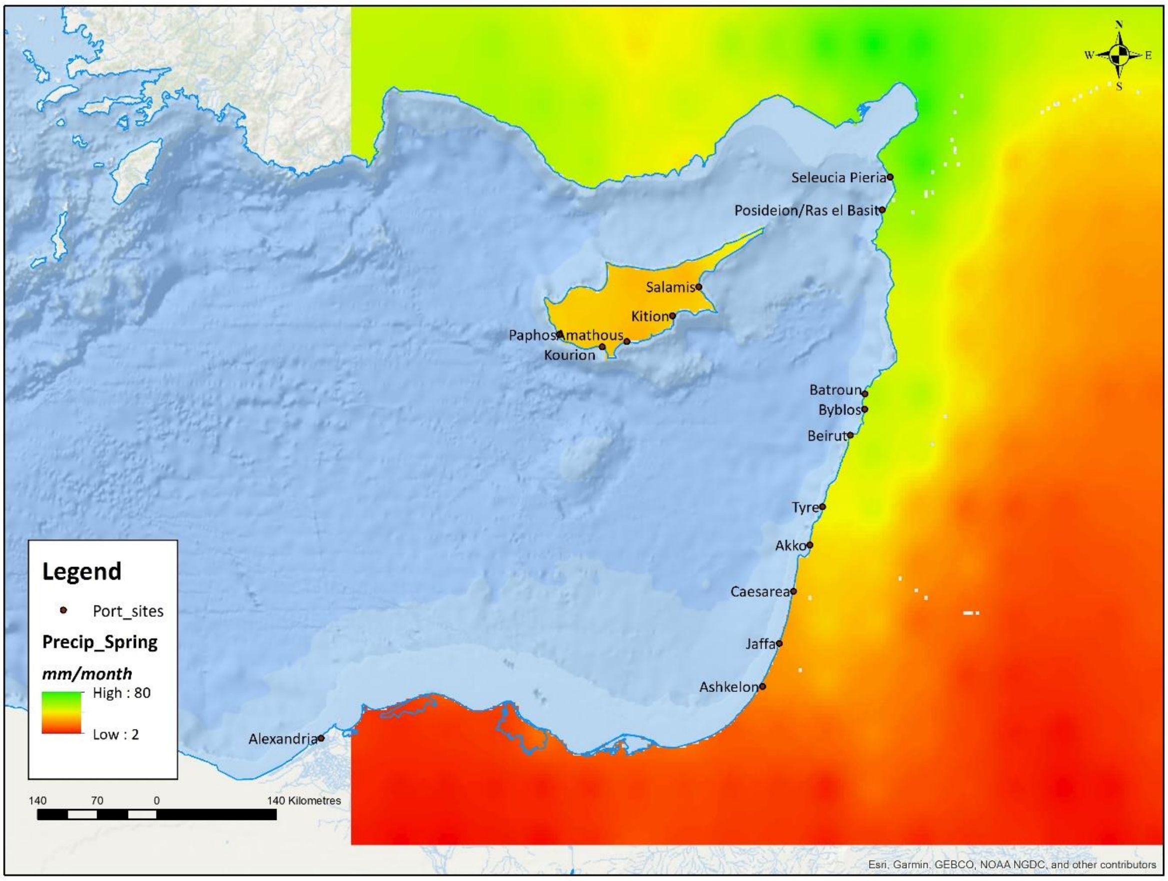


Figure A.4: Precipitation levels in Spring -- months 3, 4, 5 (data acquired from Harris et al. 2014)

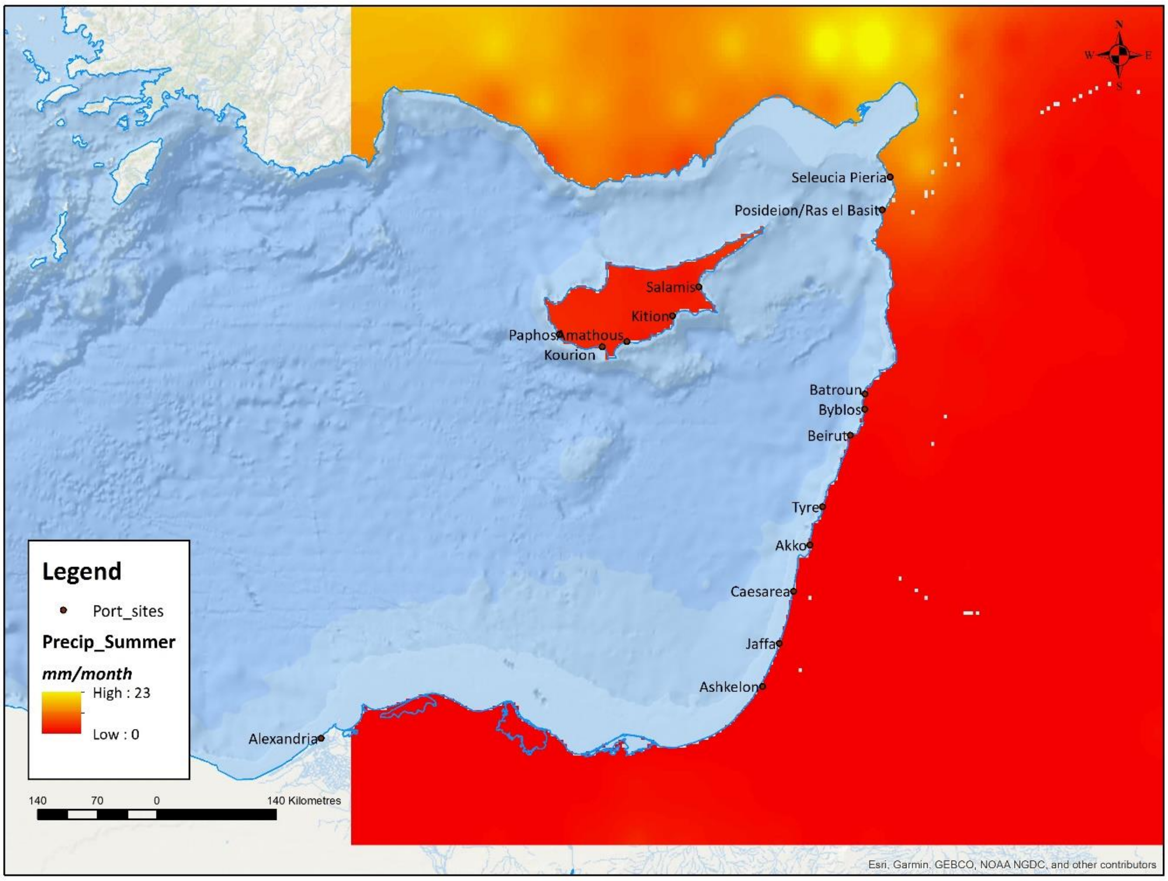


Figure A.5: Precipitation levels in Summer -- months 6, 7, 8 (data acquired from Harris et al. 2014)

Average yearly temperature was calculated in a similar fashion, utilising the IDW tool to estimate temperatures across the Levant, Asia Minor, and Egypt through weather station data acquired from Harris et al. (2014). Overall, temperatures along the Levantine coast can be divided into northern and southern zones, with central Lebanon experiencing milder temperatures (between 13 and 16). The southern Levant is slightly warmer, averaging temperatures of 17-20. When compared to topographic maps, it appears that this trend is largely related to elevation, with the Mount Lebanon Range experiencing cooler temperatures than the rest of the region. The area of modern-day Jordan can also be differentiated from the rest of the Levant with its average temperature of 21-22, similar to Egypt and the southern-most tip of the Levant. This heat becomes quite intense in Summer, with an average of 29-31.

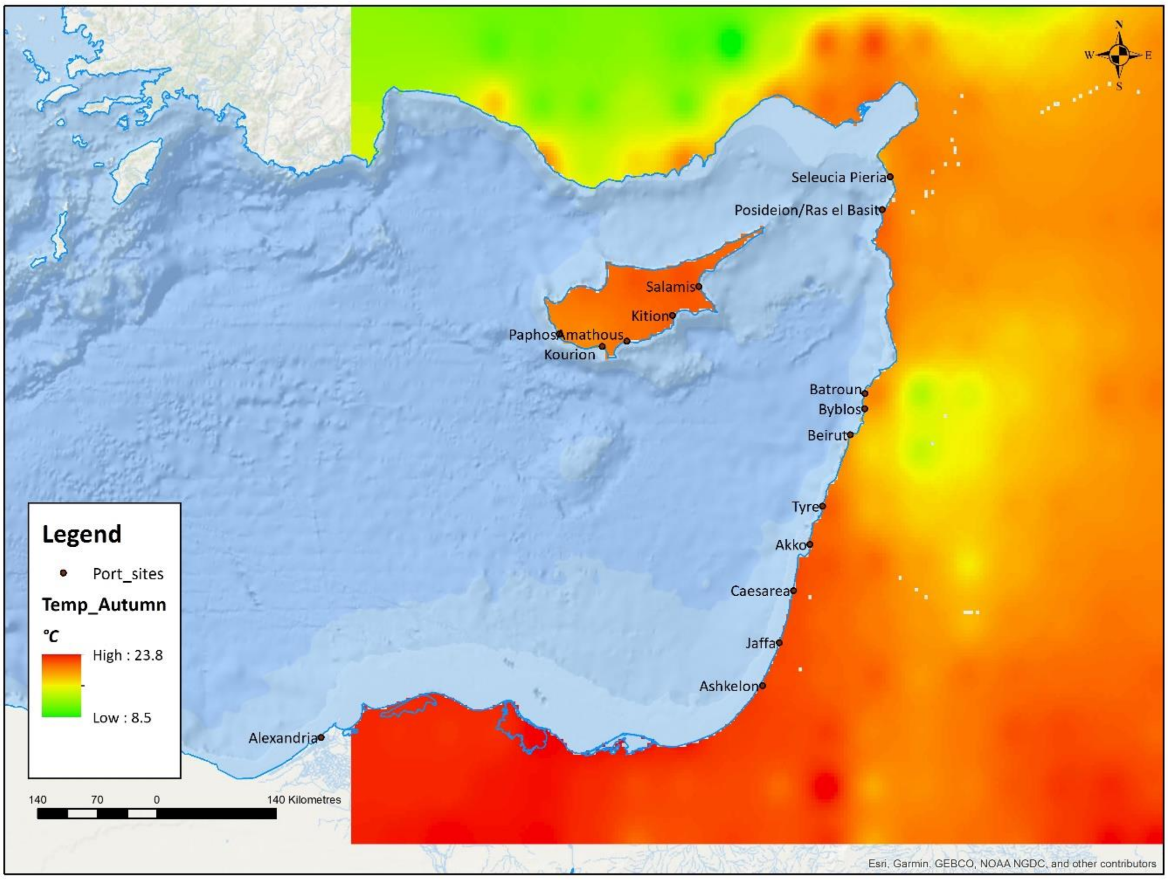


Figure A.6: Average temperature in Autumn (data acquired from Harris et al. 2014)

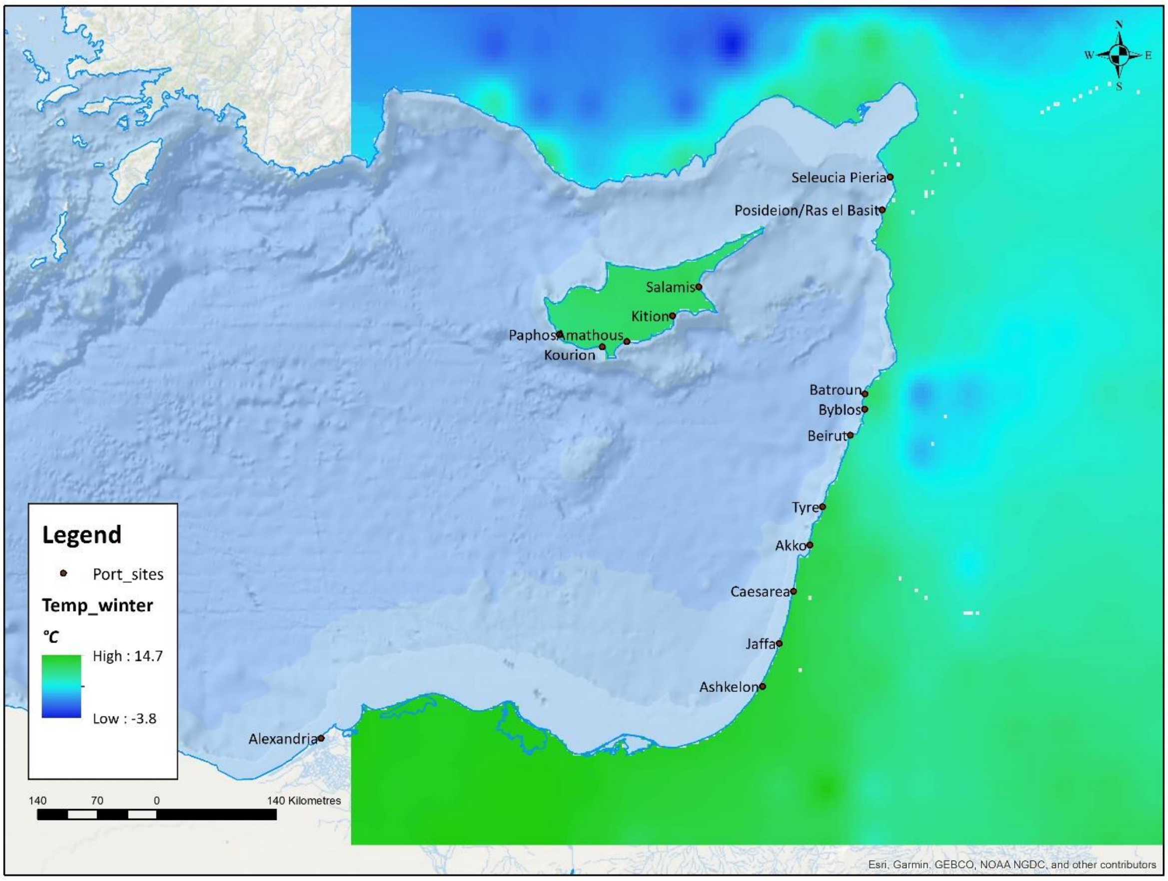


Figure A.7: Average temperature in Winter (data acquired from Harris et al. 2014)

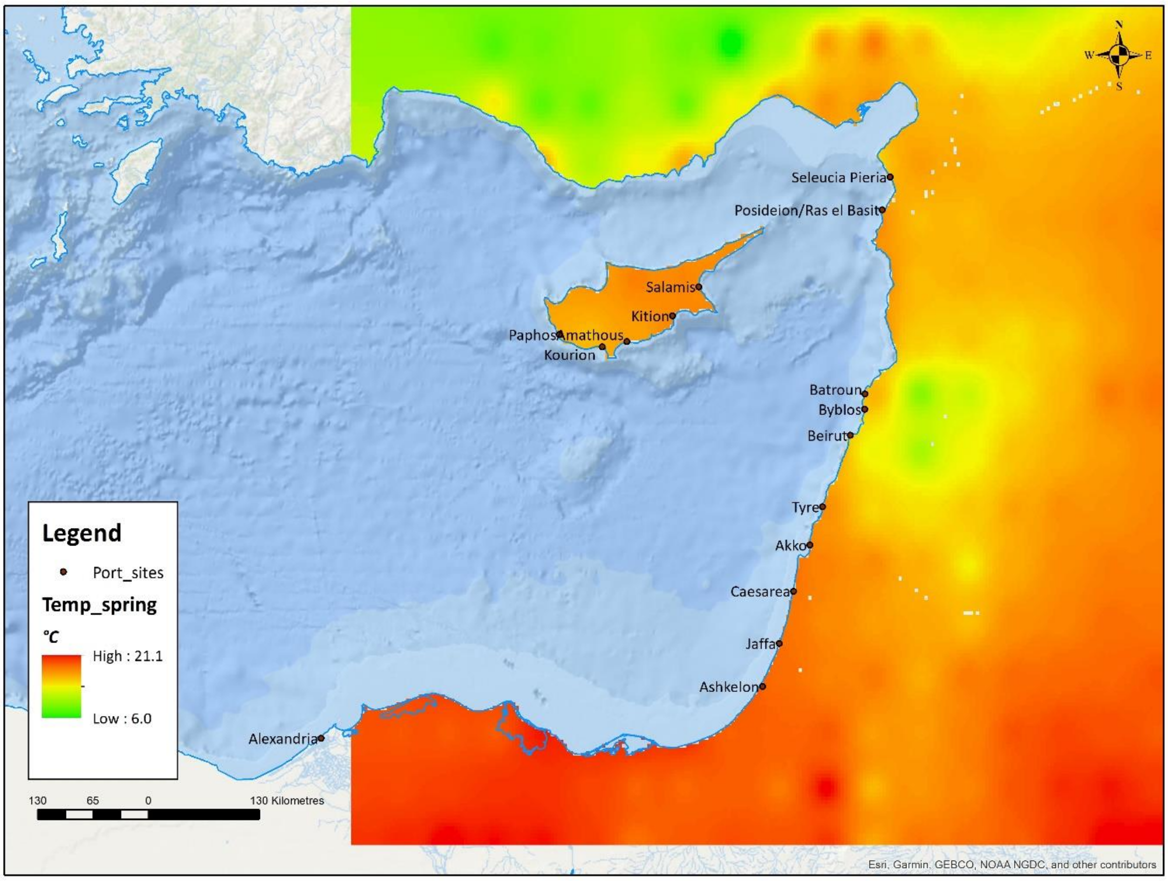


Figure A.8: Average temperature in Spring (data acquired from Harris et al. 2014)

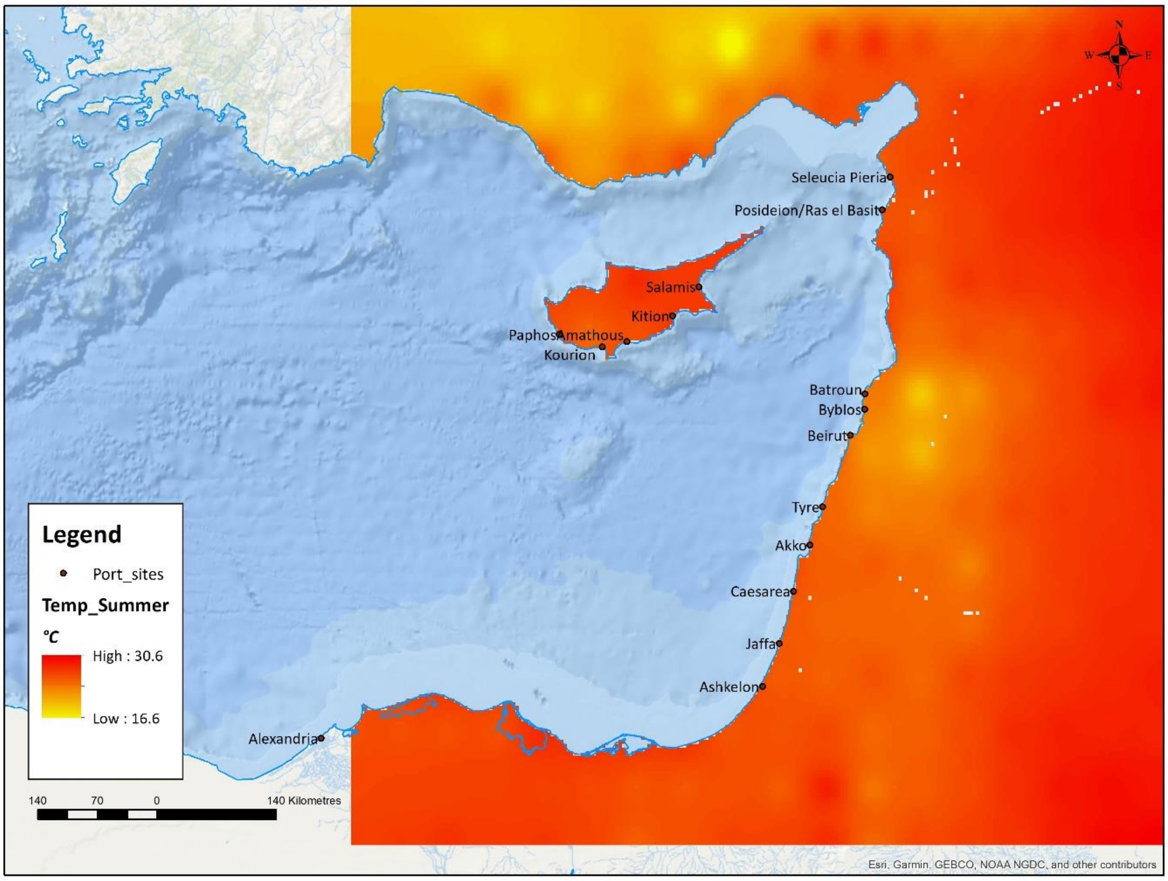


Figure A.9: Average temperature in Summer (data acquired from Harris et al. 2014)

Further north, in modern-day Turkey, temperatures are quite cooler, with cold and intense winters and mild summers. Combined with the increased levels of precipitation throughout the year, this northern area can be differentiated from the abovementioned zones of the central-northern Levant, southern Levant and south-eastern region (Jordan and inland Syria). In this way, there appears to be some level of uniformity between the Levantine coast (with some minor differences between the north and south), and this geographical zone can be regarded as meteorologically distinct from Egypt, inland Syria/Jordan, and north-eastern Turkey.

A.2 Pedogeography

In terms of soil composition, Lebanon is primarily covered by lithic leptosols (one variation of the famous Mediterranean Red Soils, or *terra rossa*), a soil type formed on hard limestone that is generally extremely shallow. It is not ideal for agriculture because of its poor ability to hold water, though it can be quite good for trees, especially olive trees, and grape vines (Darwish 2013). It is best kept under forests to prevent erosion due its shallow nature. Leptic cambisols (also known as entisols) are young and fertile soils formed in colluvial and alluvial deposits, and are ideal for agriculture (Darwish 2013: 156; Waliszewski 2014: 78-9). They cover the area north and south of Nahr el Litani in the south. Terric anthrosols, or terraced land, are soils that have been transformed by long-lasting agricultural activity. Valleys in the mountainous region east of Beirut and in the most elevated parts of the Mount Lebanon Range are covered in this soil type. They are primarily used for the agriculture of fruit trees, and distributed among marginal lands with eroded lithic leptosols (the latter generally used for grazing) (Darwish 2013: 156). Further south, Tyre is largely covered by vertic luvisols, another variation of the famous Mediterranean Red Soils, which are deep and fertile soils suitable for cultivation. This is corroborated by the numerous plantations that dot the southern Lebanese coastline today.

East of the Mount Lebanon Range, the Bekaa Valley is primarily composed of eutric cambisols, a soil type with a high content of minerals and low content of clay. It is highly suitable for arable lands and agriculture (Darwish 2013: 153). Along the lower slopes of the Mount Lebanon Range and Anti-Lebanon mountains, lithic leptosols (Mediterranean Red Soil) and terraces dominate. The contrast between cambisols and leptosols in both the north and south reflects the types of agricultural specialisation that might be most prevalent in each region. The foothills are best suited for fruit trees, grape vines and grazing, while the central, flat, wide plains allow for larger farmsteads and the agriculture of various crops (as witnessed at Kamid el Loz) (Fischer-Genz 2016: 62).

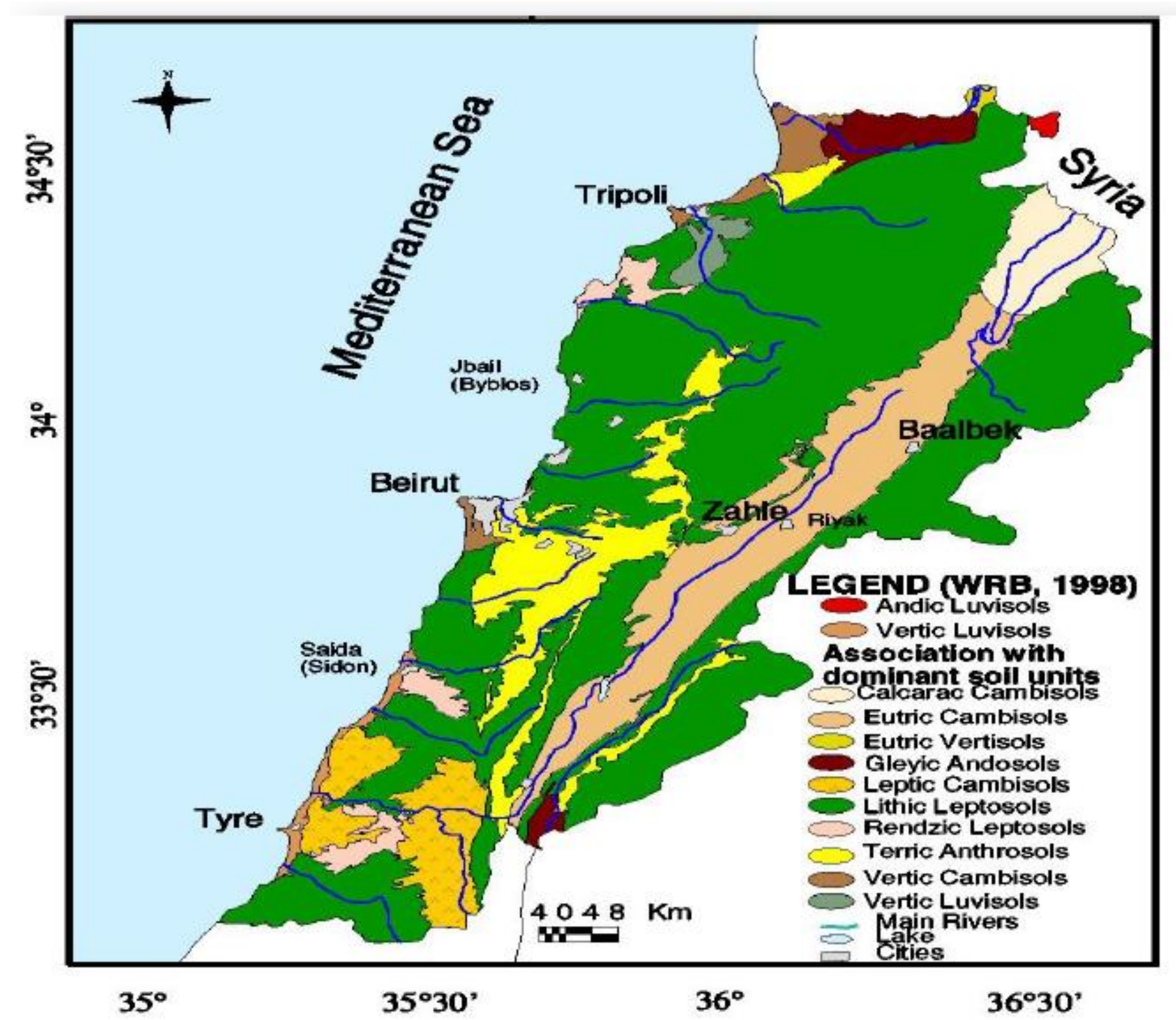


Figure A.10: Soil map of Lebanon (after Darwish 2013: 157, Fig. 3)

The area around Mount Carmel, Samaria, the coastal belt south of Caesarea Maritima and the Judaean Hills southwest of Jerusalem are covered by Mediterranean Red Soil. These deposits are not deep due to surface erosion, but are suitable for agriculture (Shapiro 2006: 1171). The remaining areas in the southern Levant are covered by a variety of soils, including entisols and vertisols, suitable for fruit trees and non-irrigated orchards as well as annual crops like barley or wheat (Shapiro 2006: 1172). The southern and south-eastern regions are covered in non-fertile and barren soils that could be irrigated to support fruit trees. Ultimately, the primary areas of fertile soil are found primarily in Galilee, near Haifa, Caesarea and the Judaean Hills, though the vast majority of the region is able to support primarily orchards, and grains in the wide, flat plains (Shapiro 2006).

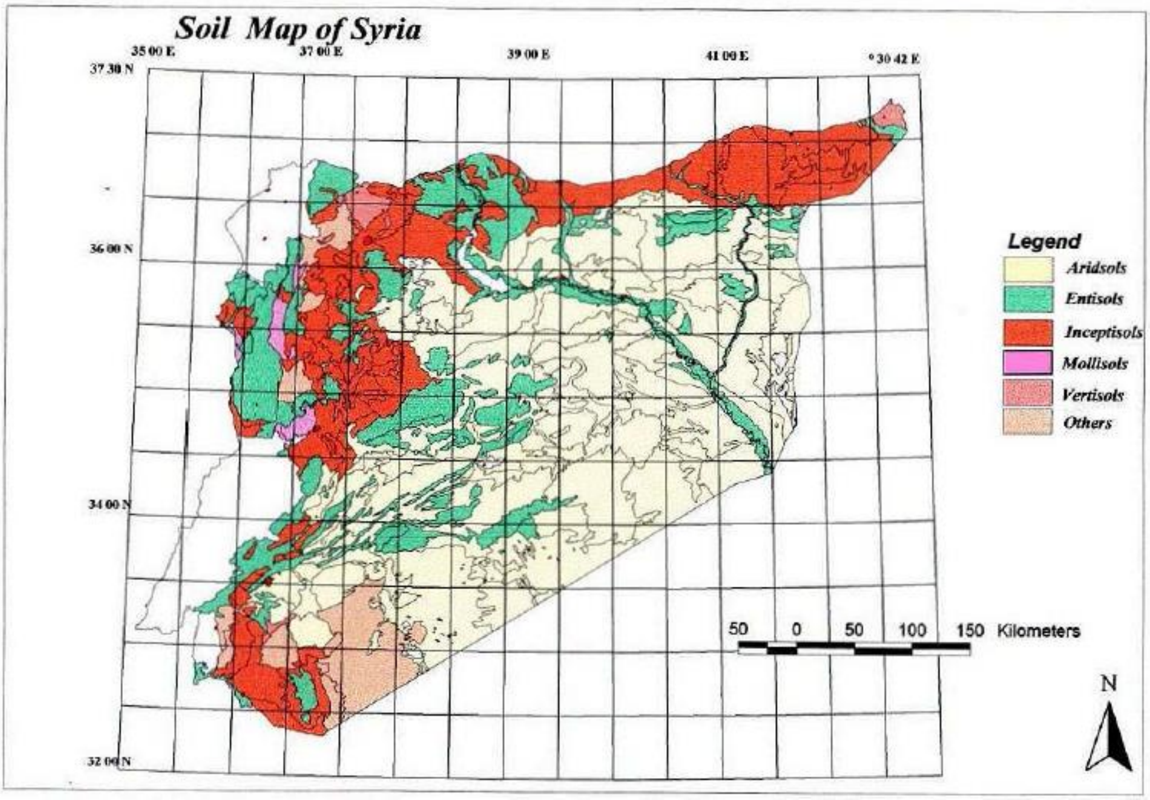


Figure A.11: Soil map of Syria (after Habib and Waad 2007)

In Syria, aridosols cover about 50% of the country, occurring largely where yearly precipitation falls below 250 mm. Entisols cover about 17% of Syria, and are most common in the Euphrates Valley and along the Euphrates River (Waliszewski 2014: 78). They are found in certain areas of Palmyra, and are relatively undeveloped soils that are characterised by a nearly unaltered profile from the parent material (generally unconsolidated sediment or rock) (Waliszewski 2014: 78). Regardless, they can be good for farming with proper sustenance and irrigation. In the north at the Limestone Massif, the region is covered in inceptisols or cambisols, similar to the Hauran. These are more developed than the previously mentioned entisols, but are still devoid of organic material and still at a relatively young age of development. They can be quite suitable for agriculture, and are not generally associated with arid environments (Khresat 2005: 16). Mollisols occur in areas with the highest rainfall in Syria. They have a well-developed structure, and are formed in semi-arid to semi-humid areas; they are found in the coastal region south of Latakkia and near Apamaea-on-the-Orontes (Habib and Waad 2007).

Syrian soils in general are not ideal for large-scale agriculture when compared to neighbouring Lebanon. Most of them are shallow, have a cemented crust close to the surface, a high degree of salinity, low organic matter, and experience significant soil degradation caused by salinization in irrigated areas, water erosion in mountainous regions, and wind erosion in steppe areas (Habib and Waad 2007). These issues are mirrored in certain regions of the central and southern Levant, but to a lesser extent. Ultimately, the coastal areas of the central and northern Levantine coast (roughly from south of Haifa to north-western Syria) prove to be well-suited for agriculture based on soil composition, topographic character and meteorological factors. The mountainous regions east of the coastal strip seem to be highly specialised for orchards and grazing. Terracing in the mountains east of Beirut appears to have been a long-standing tradition, minimising water erosion and maintaining a healthy soil (Darwish 2013). Finally, the Bekaa Valley, with an area of roughly 1200 km^2, is perhaps the most suitable agricultural centre for large-scale fields in the entire Levant due to fertile soils combined with the humid, flat terrain and mild precipitation. The Hauran region also provides fairly fertile soils and flat terrain, allowing for the cultivation of wider fields. It has been suggested that the region served as a major producer of grain and cereals in the Roman period, as attested by the possible field divisions preliminarily dated to the 1st century AD (Butcher 2003: 168-72).

Appendix B **The Near East, the Roman Near East, Roman Syria, and the Levant**

The term ‘Near East’ derives from nineteenth-century literature, when it was used to identify the remains of the Ottoman empire in the eastern Mediterranean (Van De Mieroop 2016: 3). Today, it has largely been replaced by the term ‘Middle East’, though its use persists among archaeologists and historians. However, the two terms describe regions that do not precisely overlap and each vary from study to study, requiring a brief discussion of general geographical boundaries and more specific definitions that are used in this work.

According to the National Geographic Society, the region described as the Near East encompasses the countries of Cyprus, Egypt, Iraq, Iran, Israel, Jordan, Lebanon, Palestine, Syria, Turkey and the Arabian Peninsula (Brindley 2014). In certain cases, Cyprus has been excluded from this characterisation in the past (Ball 2000: 6), though it is commonly included in more recent works regarding the Near East. This broad characterisation can be differentiated from what is sometimes referred to as the ‘Roman Near East’, which designates a smaller area that consists of modern-day Syria, Palestine/Israel, Lebanon, Jordan, and what was known in Antiquity as Mesopotamia (a region that is now divided between Turkey, Syria, and Iraq) (Ball 2000: 5-6; Butcher 2003: 10). The Roman Near East can be further distinguished from ‘Roman Syria’, which would be more closely associated with modern-day Syria, Lebanon, parts of Turkey, and parts of Palestine/Israel (Butcher 2003: 10).

It is more complicated to narrow in on a precise geographical area in discussing Roman Syria since the territorial extent expanded and shrank constantly during the Principate based on clashes with the Parthian Empire and the Sasanian Empire later. Moreover, there is a significant degree of overlap in the terms Roman Near East and Roman Syria, though they are both smaller geographical areas in comparison to the Near East as a whole, which would include the Arabian Peninsula, Egypt, and sometimes Iran. The distinction between the two is arguably the inclusion of Mesopotamia and the southern Levant, specifically Israel/Palestine and Jordan. However, this can be more finely tuned regarding the terminology used by ancient sources during the Principate.

The term ‘Levant’ corresponds more specifically to modern-day Lebanon, Syria, Palestine, Israel, Jordan and Cyprus, a geographical categorisation that was regularised during the French Mandate in Lebanon (c. 1920-1946) (Graf 2010: 248). This term, similar to the terminology outlined above, is notoriously ambiguous and variable in different publications (Killebrew and Steiner 2014: 2). It derives from the Latin *Levātiō*, meaning elevation, and can be traced to the Medieval Italian, Spanish, and Portuguese *Levante* to describe the point where the sun rises (the east in relation to Europe) (Graf 2010: 248; Van De Mieroop 2016: 6). In the 16th century, the French term *soleil levant* was used in reference to the rising sun in the east (Killebrew and Steiner 2014: 2). This eventually transitioned into the term 'Levantine' as a reference to European traders engaged in commerce on the shores of modern-day Palestine/Israel, Lebanon and Syria (Killebrew and Steiner 2014: 2).

The terms Near East and Levant are also geographical in nature, though spatial boundaries vary among archaeologists and historians. The Near East (not to be confused with the Roman Near East, which is a term to describe a region defined by ancient political structure) is bounded on the west by the Mediterranean Sea, the Red Sea in the south, the Fertile Crescent in the east, with vague and disputed boundaries in the north (Van De Mieroop 2016: 3). The Caspian Sea could be taken as a major boundary in the north (Van De Mieroop 2016: 3), though this would include all of Turkey in the characterisation, as well as bypass the Amanus and Pontus Mountains. The Levant is bounded in the north by the Amuq Plain, southeast of the Amanus Mountains in Turkey (Beitzel 2003: 3). The region extends south to the northern Sinai coast, roughly to Al Arish. The north-eastern border is more difficult to specify, but could be taken as the Euphrates near Jebel el-Bishri, and the Syrian Desert as the south-eastern border (Suriano 2013: 9-10). There is often a further differentiation between the southern and northern Levant (Suriano 2013), though such divisions are difficult to maintain as that of the Levant is strongly intertwined with modern political and cultural processes. It is not the author's intention to challenge or maintain this division, whether it is artificial or not, but simply to acknowledge its existence in modern literature to better contextualise recent research. As this study is largely based around Beirut, locations are mainly referenced in relation to the city, or, at times, in relation to their position within the abovementioned spaces of Roman Near East, Near East, or Levant.

For the purposes of this thesis, the term 'Roman Syria' is used to describe the provinces located in modern-day Lebanon, Palestine/Israel, and Syria, largely following the organisation of provinces in the Principate, with *Judaea* differentiated during relevant time periods. 'Roman Near East' refers more broadly to all provinces located in Cyprus, Egypt, Mesopotamia, Israel/Palestine, Lebanon, Jordan, Syria, parts of Turkey, and the Arabian Peninsula. The term 'Levant' is used consistent with the definition provided above, though there is an emphasis on the coast as this thesis concerns itself primarily with maritime routes. These usages mirror the author's intention of differentiating between scales of focus; the main case study examines Beirut on one level, with an extrapolation of the results to discuss implications for the wider region.

Appendix C **Catalogue of Production Sites**

Site	Lat.	Lon.	Zone	LAS press	Screw weight	Press bed	Perforated pier	Beam Counterweight	Niche for Press Beam	LAW Press	Press, Unknown Type	Date	Notes	Source
Al Jawzah	33.9270	35.8301	EZ 4	0	**1**	0	0	0	0	0	0	Roman/Byzantine		Nacouzi et al. 2014
Amioun	34.2992	35.8089	EZ 4	0	**1**	0	0	0	0	0	0	Unknown		Waliszewski 2014
Anfeh	34.3555	35.7324	EZ 1	0	0	0	0	0	**1**	0	0	13th-14th AD		Waliszewski 2014
Anjar	33.7291	35.9346	EZ 5	0	**1**	0	0	0	0	0	0	Reuse: Islamic		Waliszewski 2014
Baalbek	34.0037	36.2107	EZ 4/5	**1**	**1**	**1**	0	**1**	**1**	**1**	0	Roman/Byzantine	Wine presses	Fischer-Genz 2016
Bahdidat	34.1488	35.7070	EZ 4	0	**1**	**1**	0	0	0	0	0	Ancient?		Waliszewski 2014
Biyad	33.2048	35.3283	EZ 4	0	0	**1**	**1**	0	0	0	0	Roman/Byzantine		Waliszewski 2014
Boutmeh	33.6614	35.6210	EZ 4	0	0	0	0	0	0	0	**1**	Roman/Byzantine	Also 'agricultural' installations present	Khalil 2015
Byblos	34.1230	35.6519	EZ 1	**1**	0	0	0	0	0	0	**1**	Undated		Waliszewski 2014
Chabtine	34.2122	35.7513	EZ 4	0	0	0	0	0	0	0	**1**	Byzantine/medieval?		Waliszewski 2014
Chhîm	33.8736	35.8637	EZ 4	**1**	**1**	**1**	0	**1**	0	**1**	0	Roman-Byzantine	Mostly oil	Waliszewski 2014
Deir el Kalaa	33.8656	35.5953	EZ 4	**1**	**1**	**1**	0	0	0	0	0	Roman/Byzantine?		Waliszewski 2014

El Jouar (Ba'daran)	33.6424	35.6320	EZ 4	0	0	0	0	0	0	0	**1**	Roman/Byzantine	Roman funerary site	Khalil 2015
El Qafsiyeh	33.9296	36.2103	EZ 4	0	0	**1**	0	0	0	0	0	Unknown		Waliszewski 2014
El Qalamoun	34.3865	35.7827	EZ 1	0	0	0	**1**	0	0	0	0	Unknown		Waliszewski 2014
El-Ruweisi	33.1990	35.5306	EZ 4	0	**1**	0	0	0	0	0	0	Undated		Waliszewski 2014
Ferzol (Niha)	33.8633	35.9472	EZ 5	0	0	0	0	0	**1**	0	0	Unknown	Site adjacent to Niha. Originally a tomb and reused as a wine or oil press; probably post-Roman	Newson 2015: 368
Hawarta	33.4250	35.6167	EZ 4	0	**1**	0	0	0	0	0	0	Undated		Waliszewski 2014
Jeba	33.6106	35.6294	EZ 4	0	0	0	0	0	0	0	**1**	Roman/Byzantine	2nd/3rd century to Byzantine pottery	Khalil 2015
Jiyeh	33.6701	35.4253	EZ 1	0	0	0	0	**1**	0	0	0	Roman		Waliszewski 2014
Kamid el Loz	33.6197	35.8217	EZ 5								1	Roman	Wine press	Fischer-Genz 2016
Khan Khalde	33.7890	35.4807	EZ 1	**1**	**1**	**1**	0	**1**	0	0	0	Roman and Byzantine		Waliszewski 2014
Maaser el Chouf	33.6662	35.6670	EZ 4	0	0	0	0	0	0	0	**1**	Roman/Byzantine	Translates to 'presses of Chouf'	Khalil 2015
Majadel	33.2294	35.3601	EZ 4	0	**1**	0	0	0	0	0	0	Byzantine?		Waliszewski 2014

Majdal Zoun	33.1514	35.2271	EZ 4	0	**1**	0	0	0	0	0	0	Byzantine?		Waliszewski 2014
Mazboud	33.6102	35.4800	EZ 4	0	**1**	**1**	0	**1**	0	0	0	Roman-Byzantine		Waliszewski 2014
Qabr Hiram	33.2263	35.2742	EZ 4	0	0	0	**1**	0	0	0	**1**	Unknown		Waliszewski 2014
Qal'at el-Hosn (Faitroun)	34.0025	35.7414	EZ 5	0	0	0	0	**1**	0	0	0	Byzantine		Waliszewski 2014
Qasr Hammara	33.6484	35.8867	EZ 4/5	0	**1**	0	0	0	0	0	0	Unknown		Waliszewski 2014
Sarafand	33.4490	35.2980	EZ 1	**1**	**1**	**1**	0	0	0	0	0	Byzantine?		Waliszewski 2014
Saydet el Borj (Deir el-Ahmar)	34.1333	36.1333	EZ 4	0	0	0	0	0	0	0	**1**	Roman/Byzantine?	Wine press	Salloum 2016
Shal'abun	33.1244	35.4172	EZ 4	0	**1**	0	0	0	0	0	0	Undated		Waliszewski 2014
Sidon	33.5710	35.3729	EZ 1	0	**1**	**1**	0	0	0	0	0	Roman-Byzantine		Waliszewski 2014
Tallet Irmis	33.1451	35.1935	EZ 4	0	**1**	0	0	0	0	0	0	Undated		Waliszewski 2014
Tyre	33.2680	35.2098	EZ 1	0	**1**	**1**	**1**	0	0	0	0	Byzantine/early Islamic?		Waliszewski 2014
Umm el -'Amed	33.1188	35.1399	EZ 1	**1**	**1**	**1**	**1**	**1**	0	**1**	**1**	Hellenistic		Waliszewski 2014
Yanouh	34.1008	35.8840	EZ 4	0	0	**1**	0	0	0	0	0	7th-8th AD		Waliszewski 2014

Table 10.1: All recorded pressing installations in Lebanon before the Medieval period; LAS refers to 'lever-and-screw' press, while LAW refers to 'lever-and-weight' press

Site	**Lat.**	**Lon.**	**Zone**	**Mola Olearia**	**Trapetum**	**M.o. Date**	**Trap. Date**	**Notes**
Anfeh	34.35546	35.73235	EZ 1	**1**	0	13th/14th AD	Unknown	

Bahdidat	34.14876	35.70698	EZ 4	**1**	0	Undated	Unknown	
Biyad	33.20477	35.32827	EZ 4	**1**	0	Roman-Byzantine	Unknown	
Borjein	33.65739	35.48638	EZ 4	**1**	0	Roman-Byzantine	Unknown	
Byblos	34.12300	35.65193	EZ 1	**1**	0	Undated	Unknown	
Chhîm	33.87356	35.86375	EZ 4	**1**	**1**	Roman-Byzantine	Roman-Byzantine	
Chmis	33.63911	35.46276	EZ 4	**1**	0	Undated	Unknown	
Deir el Kalaa	33.86560	35.59530	EZ 4	**1**	0	Roman?	Unknown	
Jiyeh	33.67010	35.42530	EZ 1	**1**	**1**	Roman	Roman	
Khan Khalde	33.78900	35.48070	EZ 1	**1**	**1**	Roman and Byzantine	Roman and Byzantine	
Ma'ad	34.19566	35.68341	EZ 1	**1**	0	Undated	Unknown	
Marah Umm 'Afiyya	33.11508	35.16981	EZ 1/4	0	**1**	Unknown	Undated	Coordinates approximate, along highlands adjacent to Umm el-'Amed
Marwahin	33.10854	35.27540	EZ 4	**1**	0	Undated	Unknown	
Mazboud	33.61022	35.47996	EZ 4	0	**1**	Unknown	Roman-Byzantine	
Qabr Hiram	33.22630	35.27421	EZ 4	**1**	0	Undated	Unknown	
Qasr Naous	34.28938	35.84571	EZ 4	**1**	0	Byzantine?	Unknown	
Sarafand	33.44900	35.29800	EZ 1	**1**	0	Byzantine?	Unknown	
Shaqif el-Hardon	33.14637	35.19728	EZ 4	0	**1**	Unknown	Undated	Coordinates approximate
Sidon	33.57100	35.37290	EZ 1	**1**	0	Roman-Byzantine	Unknown	
Smar Jbeil	34.21977	35.69194	EZ 1	**1**	0	Undated	Unknown	
Talusa	33.23629	35.48511	EZ 4	**1**	0	Undated	Unknown	
Tyre	33.26800	35.20983	EZ 1	**1**	0	Undated	Unknown	
Umm el-'Amed	33.11883	35.13991	EZ 1	**1**	**1**	Hellenistic	Hellenistic	

Table 10.2: Sites in Lebanon where crushers were uncovered of the *mola olearia* and *trapetum* types

Appendix D **Catalogue of Amphorae**

D.1.1 Akko

Courthouse Site and the Hospitaller Compound (Hellenistic-Early Roman)	***Sherds (diagnostics)***	***% of total sherds***	***Product***	***Date***	***Source***	***Reference***	***Notes***
Torpedo	1	2.4	Unknown		Cypriot?	Hartal et al. 2016	
Phoenician Baggy Jar	4	9.8	Unknown	3rd BC-1st BC	Local	Hartal et al. 2016	
Phoenician Baggy Jar	10	24.4	Unknown	3rd BC-1st BC	Tyre?	Hartal et al. 2016	
Rhodian	9	22.0	Wine	3rd-1st BC	Aegean	Hartal et al. 2016	
Koan	1	2.4	Wine	Hell.		Hartal et al. 2016	Definitely under-represented in this selection. See Ariel 2005 for more description. Found with stamped handles throughout excavation, but not as recognised in this context.
Misc. Hell.	16	39.0				Hartal et al. 2016	
Total	**41**	**100**					

Table 10.3: Amphorae from terrestrial excavations at Akko, Hellenistic period

Akko Marina Archaeological Project	***MNI***	***% of total MNI (1st BC-4th AD)***	***% of total MNI (4th AD-7th AD)***	***Source***	***Reference***
Beirut 3	1	0.6		Beirut	Silberstein et al. 2017: 143, Pl. 142.11

Agora M334	1	0.6		Jiyeh	Silberstein et al. 2017: 143, Pl. 142.12
Beirut 8	1		0.4	Beirut	Silberstein et al. 2017: 154, Pl. 47.9

Table 10.4: Amphorae produced in Lebanon found in the harbour excavations, divided according to report (Roman period, Byzantine period)

D.1.2 Amathous

Agora (early)	**Sherds**	**% of total sherds**	***Reference***
Beirut 3	6	4	Kaldeli 2013bb: 417, Table 3.3.2.4.2
Hayes II	9	5	Kaldeli 2013bb: 417, Table 3.3.2.4.2
Beltr. I	3	2	Kaldeli 2013bb: 417, Table 3.3.2.4.2
Beltr. IIA	6	4	Kaldeli 2013bb: 417, Table 3.3.2.4.2
Beltr. IIB	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2
Beltr. IVA	7	4	Kaldeli 2013b: 417, Table 3.3.2.4.2
Beltr. IVB	9	5	Kaldeli 2013b: 417, Table 3.3.2.4.2
Cretan 2	3	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Dr. 20	7	4	Kaldeli 2013b: 417, Table 3.3.2.4.2
Dr. 2-4	16	9	Kaldeli 2013b: 417, Table 3.3.2.4.2
Dr. 24 imitations	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2
Dr. 28?	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2
ERA I	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Gaul. 1	3	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Gaul. 4	14	8	Kaldeli 2013b: 417, Table 3.3.2.4.2
Gaul. Imitation I	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
H. D. 5067	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Hayes I	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2

Hayes IX	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2
Hayes V	2	1	Kaldeli 2013b: 417, Table 3.3.2.4.2
Hayes VI	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Hayes VIII	5	3	Kaldeli 2013b: 417, Table 3.3.2.4.2
Maria C	5	3	Kaldeli 2013b: 417, Table 3.3.2.4.2
N. African	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pamphilian	12	7	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pamphilian?	5	3	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pinched-handle amph.	8	5	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pompeii V	4	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pseudo-Cos en cloche	3	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Pseudo-Koan	4	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Rhodian'	11	6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Sub-Koan VI	3	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Tripol III.	1	0.6	Kaldeli 2013b: 417, Table 3.3.2.4.2
Tripol. I	6	4	Kaldeli 2013b: 417, Table 3.3.2.4.2
Tripol. II	4	2	Kaldeli 2013b: 417, Table 3.3.2.4.2
Total	**165**	**100**	

Table 10.5: Amphora frequencies at Agora for early Roman types

Agora (late)	**Sherds**	**% of total sherds**	***Reference***
Beirut 8	9	2.3	Kaldeli 2013b: 456, Table 3.3.4.4.2
Cl.35	19	4.9	Kaldeli 2013b: 456, Table 3.3.4.4.2
Egloff 172	4	1.0	Kaldeli 2013b: 456, Table 3.3.4.4.2
Egloff 177	6	1.6	Kaldeli 2013b: 456, Table 3.3.4.4.2
Globular 1	10	2.6	Kaldeli 2013b: 456, Table 3.3.4.4.2
LRA I	225	58.6	Kaldeli 2013b: 456, Table 3.3.4.4.2

LRA2	9	2.3	Kaldeli 2013b: 456, Table 3.3.4.4.2
LRA3	18	4.7	Kaldeli 2013b: 456, Table 3.3.4.4.2
LRA4	13	3.4	Kaldeli 2013b: 456, Table 3.3.4.4.2
LRA 13	1	0.3	Kaldeli 2013b: 456, Table 3.3.4.4.2
Palestinian	48	12.5	Kaldeli 2013b: 456, Table 3.3.4.4.2
Spatheion	4	1.0	Kaldeli 2013b: 456, Table 3.3.4.4.2
Am. IV	18	4.7	Kaldeli 2013b: 456, Table 3.3.4.4.2
Total	**384**	**100**	

Table 10.6: Amphora frequencies at Agora for late Roman types

Palaea Lemesos	***Sherds***	***% of total sherds***	***Reference***
Am. II	8	3	Kaldeli 2013b: 421, Table 3.3.2.5.2
Am. III	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Beirut 3	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Beltr. IIA	2	0.7	Kaldeli 2013b: 421, Table 3.3.2.5.2
Beltr. IIB	6	2	Kaldeli 2013b: 421, Table 3.3.2.5.2
Beltr. III	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Beltr. IVA	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Cretan 2	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Dr. 20	2	2	Kaldeli 2013b: 421, Table 3.3.2.5.2
Dr. 2-4	3	3	Kaldeli 2013b: 421, Table 3.3.2.5.2
Dr. 2-4 imitations	79	30	Kaldeli 2013b: 421, Table 3.3.2.5.2
Garum amph. I	4	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Gaul. 3	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2

Gaul. 4?	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Gaul. imitation I	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Hayes no. 12, fig. XXXVIII	2	0.7	Kaldeli 2013b: 421, Table 3.3.2.5.2
Hayes VIII	23	9	Kaldeli 2013b: 421, Table 3.3.2.5.2
Hayes X	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Mañá C	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Pamphilian	40	15	Kaldeli 2013b: 421, Table 3.3.2.5.2
Pamphilian?	2	0.7	Kaldeli 2013b: 421, Table 3.3.2.5.2
Paphos II	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Paphos IV	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Pinched-handle amph.	7	3	Kaldeli 2013b: 421, Table 3.3.2.5.2
Pseudo-Cos en cloche	10	4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Pseudo-Koan	7	3	Kaldeli 2013b: 421, Table 3.3.2.5.2
Rhodian	5	2	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan	3	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan I	3	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan IIB	2	0.7	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan III	13	5	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan IIIB	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan IV	6	2	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan V	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan VI	3	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Sub-Koan VII	5	2	Kaldeli 2013b: 421, Table 3.3.2.5.2

Tripol. II	3	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Tripol. II	3	1	Kaldeli 2013b: 421, Table 3.3.2.5.2
Unknown II	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Unknown III	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Unknown IV	1	0.4	Kaldeli 2013b: 421, Table 3.3.2.5.2
Total	**258**	**100**	

Table 10.7: Amphora frequencies from Palaea Lemesos excavations at Amathous

D.1.3 Antioch

Antioch-on-the-Orontes	***MNI***	***% of MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
Almagro 51C?	2	6.3		3rd AD-5th AD?	Keay 19, Lusitana 4, P&W 23	Spain?	Angarone et al. 2020	Photo 4545. Possibly an Almagro 51C? No description of ware or handles, rim, profile, difficult to make definitive identification.
Almagro 54	1	3.1	Wine? Oil?	4th AD-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Palestine	Angarone et al. 2020	Photo 5118
Hayes II	1	3.1	Wine	1st AD-early 3rd AD	'carrot' amphora	Beirut	Princeton University Art Museum	Identified in Princeton online database. Labelled as from excavations in Antioch. Photo 5116. Identical to form uncovered in Paphos (observed in Metropolitan Museum of Art), seems to be stored in Princeton University Art Museum, but labelled as 'from Palmyra'. Likely a variant of Beirut Type (more edged shoulder instead of rounded, see Kaldeli 2013b: 356). Assumed that this is same vessel as seemingly identical one labelled today as 'from Palmyra', treated as single example.
Chalk 6	1	3.1	Unknown	3rd AD-4th AD	Augst 53, P&W 50	Unknown	Angarone et al. 2020	

Greco-Italic	7	21.9	Wine	1st BC?	Lamboglia 4, P&W 2, Republicaine 1	W. Med.	Angarone et al. 2020	Possibly Italy. Earliest form identified, essentially 100% of Hellenistic forms identified.
Kapitan II	1	3.1	Wine?	2nd AD-4th AD	Benghazi MRA 7 Hollow Foot Amphora, Kuzmanov 7, Niederbieber 77, Ostia 6, P&W 47, Zeest 79	Aegean?	Angarone et al. 2020	Photo 4536
Kuzmanov 9	1	3.1	Wine?	4th AD-5th AD	Carrot' amphora	Seleucia Pieria?	Angarone et al. 2020	Photo 4543
LRA 1	10	31.3	Wine	3rd AD-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Angarone et al. 2020	Photo 727, 2147, 4536, 4544, 5117
LRA3	2	6.3	Unknown	4th AD-6th AD	Ballana 13a, Benghazi LRA 10, British B4, Carthage LRA 3, Kuzmanov 7, P&W 45, Scorpan 5, Zeest 95	Asia Minor	Angarone et al. 2020	Photo 4541, 5234
Unidentified	6	18.8	Unknown	Unknown		Unknown	Angarone et al. 2020	Photo 4541, 4546. They appear to be late vessels. Parallel at Ashkelon (labelled as Benghazi miscellaneous)? (Johnson 2008aa: 158)
Total	**32**	**100.0**						

Table 10.8: Amphora frequencies from excavations at Antioch, identified from photo archive

D.1.4 Apollonia

Apollonia	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
LRA 5	14	48.3	14	48.3	Wine	6th AD-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Grossmann 2001: 81-93	8 listed but not photographed in ceramic assemblage

Almagro 54	5	17.2	5	17.2	Wine? Oil?	4th AD-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Palestine	Grossmann 2001: 81-93	
Unknown	6	20.7	6	20.7					Grossmann 2001: 81-93	
Unknown (Baetica?)	1	3.4	1	3.4		3rd-5th AD			Grossmann 2001: 81-93	Possibly a Keay XIIIC
Beirut 5?	1	3.4	1	3.4	Wine?	4th-5th AD		Beirut	Grossmann 2001: 81-93	Only body sherd remaining, thus could also possibly be a Beirut 7. Without rim, difficult to make definitive identification
Mauretanian	1	3.4	1	3.4		Late Roman/Byzantine?		N. Africa	Grossmann 2001: 81-93	Unspecified Mauretanian Late Roman/Early Byzantine Amphora
LRA 1	1	3.4	1	3.4	Wine and oil	6th AD-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Grossmann 2001: 81-93	
Total	**29**	**100**	**29**	**100**						

Table 10.9: Amphora frequencies from underwater excavations at Apollonia

D.1.5 Ashkelon

Ashkelon 1995-1998, varied	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***

Africana 2 Grande (unspecified)	3	1.3	2	1.1	Unknown	2nd AD-4th AD		N. Africa	Johnson 2008aa: 166	Olive oil, wine, and fish sauce have all been suggested
Africana 2D Grande	10	4.4	4	2.3	Fish sauce or wine	3rd AD-4th AD	Keay 7	N. Africa	Johnson 2008aa: 164-65	Johnson suggests olive oil, but recent work has indicated fish sauce or wine to be more likely.
Africana I 'Picolo'	1	0.4	1	0.6	Olive oil	2nd AD-4th AD	Beltrán 57, Keay 3, Ostia 4, P&W 33	N. Africa	Johnson 2008aa: 163	Johnson suggests possibly fish sauce?
Agora M254 (Type A)	2	0.9	2	1.1	Wine?		P&W 40, Benghazi MRA 1	N. Africa	Johnson 2008a: 160	Possible produced in Tripolitania
Beirut 3	1	0.4	1	0.6	Wine	1st AD-2nd AD		Levant	Johnson 2008a: 152	
Beltrán 72	1	0.4	1	0.6	Fish sauce	3rd AD-5th AD		Spain	Johnson 2008a: 159	
Benghazi ERA 11A	3	1.3	2	1.1	Unknown	1st AD		N. Africa	Johnson 2008a: 145	Possibly produced in Tripolitania
Benghazi ERA 14	1	0.4	1	0.6	Unknown	1st AD-3rd AD		N. Lebanon?	Johnson 2008a: 159	See Riley 1979: 170-71 for details
Benghazi ERA 2	1	0.4	1	0.6	Unknown	2nd AD		N. Africa	Johnson 2008a: 146	Identification tentative
Benghazi ERA 7	1	0.4	1	0.6	Unknown	1st AD-2nd AD		Unknown	Johnson 2008a: 145	
Benghazi LRA 11	2	0.9	2	1.1	Unknown	3rd AD-5th AD		Unknown	Johnson 2008a: 167	
Benghazi LRA 12	2	0.9	2	1.1	Unknown	4th AD-5th AD		Unknown	Johnson 2008a: 167	
Benghazi LRA 12	1	0.4	1	0.6	Unknown	Late Roman		Unknown	Johnson 2008a: 179	

Benghazi LRA 5	4	1.8	4	2.3	Unknown	7th AD-8th AD		Egypt?	Johnson 2008a: 177	
Benghazi LRA 7	1	0.4	1	0.6	Unknown	Late Roman		Unknown	Johnson 2008a: 179	Tentative identification, fabric not exactly a match
Benghazi LRA 9	2	0.9	2	1.1	Unknown	5th AD		Unknown	Johnson 2008a: 170	
Benghazi Misc. D298/D299	3	1.3	3	1.7	Unknown	2nd AD-3rd AD		Unknown	Johnon 2008: 157-68	See Riley 1979: 250-6 for details
Benghazi MRA 11	1	0.4	1	0.6	Wine or Fish Sauce	1st AD-3rd AD		Gaul?	Johnson 2008a: 161	
Benghazi MRA 18	2	0.9	1	0.6	Unknown	1st AD-3rd AD		Aegean or Black Sea	Johnson 2008a: 149	
Benghazi MRA 3	8	3.6	1	0.6	Unknown	1st AD-4th AD		Asia minor?	Johnson 2008a: 150	Precursor to LRA 3. Not generally differentiated in other reports.
Benghazi MRA 4	10	4.4	6	3.4	Wine	1st AD-4th AD	Agora G 199, Nea Paphos 3, Ostia 631, 'pinched-handle' amphora, Zemer 41	Cilicia	Johnson 2008a: 153-155	Multiple, unspecified sherds (10+)
Benghazi unknown type	1	0.4	1	0.6	Unknown	2nd AD		N. Africa	Johnson 2008a: 149	
Carthage Amphora '65'	1	0.4	1	0.6	Unknown	500 AD		Unknown	Johnson 2008a: 175	
Carthage Early Roman Amphora IV	2	0.9	1	0.6	Wine? Fish Sauce?	1st BC-1st AD		N. Africa	Johnson 2008a: 143	Rim differs from most other Carthage ERA 4 (less everted, no horizontal lip moulded on underside)
Dressel 20	2	0.9	2	1.1	Olive Oil	1st AD-3rd AD	Beltrán 5 Callender 2, Globular amphora, Ostia 1, P&W 25	Spain	Johnson 2008a: 147-48	

Dressel 21-22	2	0.9	1	0.6	Fruit?	1st BC-1st AD	Callender 4, Ostia 54, P&W 7, Schoene 4	Italy?	Johnson 2008a: 144	
Dressel 2-4	7	3.1	7	4.0	Wine	1st BC-1st AD	Camulodunum 182/183, Koan Amphora, P&W 10	Italy, varied	Johnson 2008a: 139-40	1 from Campania
Dressel 38	1	0.4	1	0.6	Fish Sauce	1st AD-2nd AD	Augst 27, 29, Callender 6, Camulodunum 186C, P&W 18, Pélichet 46		Johnson 2008a: 147	
Egloff 172	10	4.4	3	1.7	Wine	4th AD-7th AD	P&W 53	Egypt	Johnson 2008a: 174-75	From the Nile region
Gauloise 4	1	0.4	1	0.6	Wine	1st AD-3rd AD	Augst 12, Callender 10, Niederbieber 76, Ostia 60, P&W 27, Pélichet 47	W. Med.	Johnson 2008a: 149	New identification, requires refining of fabric analysis to be certain of source. Type produced in France and Spain.
Greco-Italic	8	3.6	7	4.0	Wine. Fish Sauce?	1st BC	Lamboglia 4, P&W 2, Republicaine 1	W. Med.	Johnson 2008a: 141-43	Probably from Italy, 2 specimens might be for fish sauce
Kapitan II	9	4.0	4	2.3	Wine?	2nd AD-4th AD	Benghazi MRA 7 Hollow Foot Amphora, Kuzmanov 7, Niederbieber 77, Ostia 6, P&W 47, Zeest 79	Aegean?	Johnson 2008a: 155-157	
Keay 16	1	0.4	1	0.6	Unknown	2nd AD-4th AD		Spain	Johnson 2008a: 163	
Keay 1A	1	0.4	1	0.6	Probably Wine	3rd AD	Augst 15, Dressel 30, Ostia 5, P&W 38	N. Africa	Johnson 2008a: 161	Produced in Mauretania, widely distributed in W. Med
Keay 1B	2	0.9	2	1.1	Probably Wine	3rd AD-4th AD		N. Africa	Johnson 2008a: 162	
Keay 74	2	0.9	2	1.1	Unknown	7th AD		Unknown	Johnson 2008a: 175-76	

LRA 1	4	1.8	4	2.3	Wine and oil	6th-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possible Syria	Johnson 2008a: 172-73	Probably wine
LRA 2	2	0.9	2	1.1	Wine and oil	6th-7th AD	Benghazi LRA 2, British B1, Carthage LRA 2, Keay 65, Kuzmanov 19, P&W 43, Scorpan 7A	Aegean, possibly E. Med.	Johnson 2008a: 170-71	Probably olive oil
LRA3	8	3.6	6	3.4	Unknown	4th-6th AD	Ballana 13a, Benghazi LRA 10, British B4, Carthage LRA 3, Kuzmanov 7, P&W 45, Scorpan 5, Zeest 95	Asia Minor	Johnson 2008a: 171-72	
Paphos Type 5	5	2.2	2	1.1	Unknown	2nd AD		Unknown	Johnson 2008a: 148	
Psuedo-Koan	1	0.4	1	0.6	Wine?	1st-2nd AD	P&W 11, Benghazi ERA 2	Unknown	Johnson 2008a: 144	
Rhodian Type	5	2.2	5	2.9	Probably Wine	1st BC-2nd AD	Augst 6, Callender 7, Camulodunum 184, Ostia 65, P&W 9	Aegean	Johnson 2008a: 137-38	2 specimens similar to fabric 1 of P&W (5 YR 7/6), others of a different fabric
San Lorenzo Amphora 7	5	2.2	4	2.3	Unknown	3rd AD-6th AD		E. Med	Johnson 2008a: 168-69	Name attributed to form of amphora after the type uncovered in Milan; based on clay, eastern production more likely
Spatheion 1	3	1.3	3	1.7	Unknown	4th AD-5th AD	Benghazi LRA 8, Keay 26, P&W 51	N. Africa	Johnson 2008a: 176	
Unclassified (Early Rom. to Mid Rom.)	11	4.9	10	5.7	Unknown	1st AD-2nd AD		Unknown	Johnson 2008a: 181-83	
Unclassified (Hel. to early Rom.)	5	2.2	5	2.9	Unknown	1st BC-1st AD		Unknown	Johnson 2008a: 180-81	

Unclassified (Mid. Rom)	2	0.9	2	1.1	Unknown	2nd AD-3rd AD		Unknown	Johnson 2008a: 184	
Unclassified (Mid. to Late Rom.)	54	24.0	47	26.9	Unknown	3rd AD-6th/7th AD		Unknown	Johnson 2008a: 184-96	
Unclassified Egyptian	4	1.8	3	1.7	Unknown	5th AD-7th AD		Egypt	Johnson 2008a: 178	Sourced and dated based on clay and slip, but not given more specific classification
Van der Werff 1	1	0.4	1	0.6	Fish sauce?	2nd BC to early-1st AD	Cintas 312, Dressel 18, Maña C2B, Martin-Kilcher A1-6, Neo Punic, P&W 32, Ramón T-7.4	N. Africa	Johnson 2008a: 141	
Villa of Dionysos at Knossos Type 18	1	0.4	1	0.6	Unknown	2nd AD-3rd AD		Unknown	Johnson 2008a: 157	
Villa of Dionysos at Knossos Type 2	4	1.8	4	2.3	Unknown	2nd AD-3rd AD		Aegean	Johnson 2008a: 151-52	Multiple, unspecified sherds (4+)
Total	**225**	**100.0**	**175**	**100.0**						

Table 10.10: Amphora frequencies from Ashkelon

D.1.6 Caesarea

Area LL	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
Almagro 54	36	22.0	36	22.0	Wine	6th-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Gaza	Oren-Paskal 2008: 49-50	Probably wine based on resin or bitumen on interior
LRA 5 (southern?)	59	36.0	59	36.0	Wine	6th-7th AD	Palestinian bag-shaped amphora	Palestine	Oren-Paskal 2008: 50-53	Probably wine, though other material has been

										suggested. Labelled specifically as 'southern Palestinian bag-shaped'
T.3 Black (possibly LRA 6)	12	7.3	12	7.3	?	6th-7th AD		?	Oren-Paskal 2008: 50	Type not specified, seemingly local, not Beirut
T.3 Brown? (possibly LRA 6)	8	4.9	8	4.9	?	6th-7th AD		?	Oren-Paskal 2008: 50	Type not specified, seemingly local, not Beirut
LRA 5 (northern?)	9	5.5	9	5.5	Wine	6th-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Oren-Paskal 2008: 50	Probably wine, though other material has been suggested. Labelled specifically as 'northern Palestinian bag-shaped'
Egyptian	11	6.7	11	6.7	Wine	6th-7th AD			Oren-Paskal 2008: 50	No further subdivisions given, though almost all probably are wine amphorae
LRA 1	9	5.5	9	5.5	Wine and oil	6th-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Oren-Paskal 2008: 50	Probably wine

LRA 2	14	8.5	14	8.5	Wine and oil	6th-7th AD	Benghazi LRA 2, British B1, Carthage LRA 2, Keay 65, Kuzmanov 19, P&W 43, Scorpan 7A	Aegean, possibly E. Med.	Oren-Paskal 2008: 50	Probably olive oil
Misc.	6	3.7	6	3.7					Oren-Paskal 2008: 50	
Total	**164**	**100.0**	**164**	**100**						

Table 10.11: Amphora frequencies from Area LL in Caesarea, Byzantine/Muslim period

Harbour and Outer Bay	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
Greco-Italic	1	0.9	1	0.9	Wine	1st BC	Lamboglia 4, P&W 2, Republicaine 1	W. Med.	Oleson et al. 1994: 4	Possibly Italy
Lamboglia 2 OR Dressel 6	1	0.9	1	0.9	Probably Wine. Possibly garum or olive oil.	1st AD	Apani 1, Baldacci 1, P&W 8 for Lamboglia 2; Augst 38 for Dressel 6A; Augst 37 for Dressel 6B	W. Med.	Oleson et al. 1994: 4	
Rhodian Type	10	8.9	10	8.9	Probably Wine. Possibly figs?	3rd BC-2nd AD	Augst 6, Callender 7, Camulodunum 184, Ostia 65, P&W 9	Aegean	Oleson et al. 1994: 4	
Dressel 2-4	5	4.5	5	4.5	Wine	1st BC-1st AD	Camulodunum 182/183, Koan Amphora, P&W 10	Spain	Oleson et al. 1994: 4	
Psuedo-Koan	2	1.8	2	1.8	Wine?	1st AD-2nd AD	P&W 11, Benghazi ERA 2	Unknown	Oleson et al. 1994: 10	
Almagro 51	2	1.8	2	1.8	Fish Sauce	Byzantine	Keay 19, Lusitana 4/7, P&W 23	Spain	Oleson et al. 1994: 4	From Lusitania, specifically
Oberaden 83	2	1.8	2	1.8	Olive oil	late-1st BC-early 1st AD	Dressel 25, Haltern 71, P&W 24	Spain	Oleson et al. 1994: 4	Antecedent of Dressel 20, produced in Guadalquivir

Gauloise 3	2	1.8	2	1.8	Wine	1st AD	P&W 29, Augst 11, Bertucchi 7A	Gaul	Oleson et al. 1994: 4	
Dressel 28	1	0.9	1	0.9	Wine?	late-1st AD to early-2nd AD	P&W 31, Augst 9	Spain or Gaul	Oleson et al. 1994: 4	Sourced to Baetica or France, specifically
Africana II (unspecified)	2	1.8	2	1.8	Wine or fish sauce?	2nd AD-3rd AD	Keay 4, 5, 6, 7	N. Africa	Oleson et al. 1994: 4	
Crétoise 2	3	2.7	3	2.7	Wine?	1st-3rd AD	Benghazi ERA 1, P&W 39	Crete	Oleson et al. 1994: 4	
Agora M254	1	0.9	1	0.9	Wine?	1st AD-4th AD	P&W 40, Benghazi MRA 1	N. Africa, Sicily	Oleson et al. 1994: 10	Type A from Tripolitania?, Type B from Sicily?
Forlimpopoli	1	0.9	1	0.9	Wine or fish sauce?	1st BC-3rd AD	Benghazi MRA 13, P&W 42	Italy	Oleson et al. 1994: 4	
LRA 1	2	1.8	2	1.8	Wine and oil	6th-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possible Syria	Oleson et al. 1994: 4	Probably wine
LRA3	2	1.8	2	1.8	Unknown	4th-6th AD	Ballana 13a, Benghazi LRA 10, British B4, Carthage LRA 3, Kuzmanov 7, P&W 45, Scorpan 5, Zeest 95	Asia Minor	Oleson et al. 1994: 4	
LRA 5	7	6.3	7	6.3	Wine	6th-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Oleson et al. 1994: 4	Probably wine, though other material has been suggested
Kapitan II	8	7.1	8	7.1	Wine?	2nd-4th AD	Benghazi MRA 7 Hollow Foot Amphora, Kuzmanov 7, Niederbieber 77, Ostia 6, P&W 47, Zeest 79	Aegean?	Oleson et al. 1994: 4	

Almagro 54	9	8.0	9	8.0	Wine	6th-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Gaza	Oleson et al. 1994: 4	Probably wine based on resin or bitumen on interior
a	1	0.9	1	0.9					Oleson et al. 1994: 4	Difficult to more specifically attribute these forms to specific ceramic forms, would require in-depth examination. Will be listed as such for this analysis. None of them are similar to Beirut Type, though a number lack photographs for more close identification.
b	1	0.9	1	0.9					Oleson et al. 1994: 4	
c	1	0.9	1	0.9					Oleson et al. 1994: 4	
d	1	0.9	1	0.9					Oleson et al. 1994: 4	
e	12	10.7	12	10.7					Oleson et al. 1994: 4	
f	1	0.9	1	0.9					Oleson et al. 1994: 4	
g	8	7.1	8	7.1					Oleson et al. 1994: 4	
h	5	4.5	5	4.5					Oleson et al. 1994: 4	
i	2	1.8	2	1.8					Oleson et al. 1994: 4	
j	1	0.9	1	0.9					Oleson et al. 1994: 4	
k	2	1.8	2	1.8					Oleson et al. 1994: 4	
misc	13	11.6	13	11.6					Oleson et al. 1994: 4	
Beirut 8	1	0.9	1	0.9					Oleson et al. 1994: 22	Amphora A.38 in assemblage
Lids	2	1.8	2	1.8					Oleson et al. 1994: 4	

Total	112	100.0	112	100	

Table 10.12: Amphora frequencies in harbour of Caesarea

D.1.7 Jiyeh

Jiyeh well (Early Roman)	% of all ceramic sherds	Product	Date	Source	Reference	Notes
Beirut 2	40	Wine	1st AD	Jiyeh	Wicenciak 2016b: 77-78	Two sherds with more rectangular rim, similar to Beirut 1.2b. Probably more than 80% of amphora assemblage from well.
Jiyeh 7	2	Unknown	Early Roman	Unknown	Wicenciak 2016b: 79	
Jiyeh 8	1	Unknown	Early Roman	Unknown	Wicenciak 2016b: 79	
Jiyeh 9	1	Unknown	Early Roman	Unknown	Wicenciak 2016b: 79-80	
Jiyeh 10	>1	Garum?	Early Roman	Spain?	Wicenciak 2016b: 80	Hypothesised to be prototype vessel that never went into production, since not observed in residential quarter. Parallel found in Beirut (Reynolds 2003: 123, Fig. 5).

Table 10.13: Rough estimate of amphora sherd percentages from well B4 from rescue excavations at Jiyeh

D.1.8 Kourion

Kourion	Sherds	% of total sherds	Reference	Notes
`Rhodian'	5	1.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Am. II	6	1.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Beirut 2	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Beltr. IIA	1	0.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Beltr. IIB	4	1.2	Kaldeli 2013b: 426, Table 3.3.2.6.2	

Dr. 20	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Dr. 2-4	7	2.2	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Dr. 2-4 imitations 9	91	28.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Garum amph. 1	4	1.2	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Gauloise	1	0.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
H. D. 5083	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Hayes VI	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Hayes VIII	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Hole-mouthed' amphora	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	Lebanese, not definitely Beirut product, probably Late Hellenistic-Early Roman
Kourion I	47	14.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Kourion IV	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Kourion XIV	1	0.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
N. Afr. garum amph.	6	1.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
N. African	8	2.5	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Pamphilian	28	8.7	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Pamphilian?	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Pinched-handle amph.	28	8.7	Kaldeli 2013b: 426, Table 3.3.2.6.2	

Pseudo-Cos en cloche	4	1.2	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Pseudo-Koan	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan II	1	0.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan IIB	4	1.2	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan III	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan IV	11	3.4	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan V	29	9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Sub-Koan VII	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Tripol. III	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Unknown II	1	0.3	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Unknown IV	5	1.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Total	**322**	**100**		

Table 10.14: All amphora percentages from Kourion in Roman period

Kourion	***Sherds (diagnostics)***	***% of total sherds***	***Reference***	***Notes***
Beirut 2	3	0.9	Kaldeli 2013b: 426, Table 3.3.2.6.2	
Beirut 8	5	1.4	Kaldeli 2013b: 463, Table 3.3.4.6.2	Also, base of Beirut 8 observed in Episcopal precinct (Hayes 2007: 462, Fig. 14.5.E16); same frequency as assemblage presented by Kaldeli
Hole-mouthed amphora	2	0.6	Kaldeli 2013b: 426, Table 3.3.2.6.2	Lebanese, not definitely Beirut product, probably Late Hellenistic-Early Roman

Table 10.15: All Lebanese amphorae observed at Kourion, all periods

D.1.9 Limyra

LI 96 SO 21	*Sherds (diagnostics)*	*% of total diagnostics*	*Product*	*Date*	*Other Names*	*Source*	*Reference*	*Notes*
Bag-shaped (LRA 5 imi.)	1	1.1	Wine	7th AD-9th AD		Egypt?	Vroom 2007: 267	
LRA 1	13	14.9	Wine and oil	6th AD-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Vroom 2007: 267	Probably wine
LRA 2	5	5.7	Wine and oil	6th AD-7th AD	Benghazi LRA 2, British B1, Carthage LRA 2, Keay 65, Kuzmanov 19, P&W 43, Scorpan 7A	Aegean, possibly E. Med.	Vroom 2007: 267	Probably olive oil
LRA 5	6	6.9	Wine	6th AD-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Vroom 2007: 267	Probably belong to 3 vessels
LRA 7	17	19.5	Wine	4th AD-7th/8th AD	Bailey Type B, Egloff 173, 174, 177, P&W 52B	Egypt	Vroom 2007: 267	Probably belong to 2 vessels
Misc.	45	51.7					Vroom 2007: 267	
Total	**87**	**100.0**						

Table 10.16: Byzantine period amphora frequencies from Limyra, early periods not available

Eastern City Total	*Sherds (diagnostics)*	*% of total diagnostics*	*Product*	*Date*	*Other Names*	*Source*	*Reference*	*Notes*
Almagro 54	5	1.0	Wine	6th-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Gaza	Vroom 2004: 292	

LRA 1	238	46.4	Wine and oil	6th AD-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Vroom 2004: 292	Probably wine
LRA 2	52	10.1	Wine and oil	6th AD-7th AD	Benghazi LRA 2, British B1, Carthage LRA 2, Keay 65, Kuzmanov 19, P&W 43, Scorpan 7A	Aegean, possibly E. Med.	Vroom 2004: 292	Probably olive oil
LRA 5	10	2.0	Wine	6th AD-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Vroom 2004: 292	
LRA 7	57	11.1	Wine	4th AD-7th/8th AD	Bailey Type B, Egloff 173, 174, 177, P&W 52B	Egypt	Vroom 2004: 292	
LRA3	16	3.0	Unknown	4th-6th AD	Ballana 13a, Benghazi LRA 10, British B4, Carthage LRA 3, Kuzmanov 7, P&W 45, Scorpan 5, Zeest 95	Asia Minor	Vroom 2004: 292	
Misc.	134	26.3					Vroom 2004: 292	
Total	**512**	**100.0**						

Table 10.17: Amphora frequencies at Limyra in eastern area, given as rough percentages

D.1.10 Panayia Ematousa

Panayia Ematousa (Hell. to Roman)	***MNI***	***% of total MNI***	***Reference***	***Notes***
Beirut 3	2	1.2	Winther Jacobsen 2005: 314	
AM 72?	1	0.6	Winther Jacobsen 2005: 332, Fig. 166: A58.119	Possibly from N. Lebanon, possibly Beirut? Description of ware is difficult to pinpoint.

Table 10.18: Lebanese amphorae from Panayia Ematousa

D.1.11 Paphos

Saranda Kolones Castle	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
Agora G199	9	9	5	6.2	Unknown	1st-2nd AD?	Dyczek 2001, MRA 4, Paphos Type III, Ostia 631, Pinched Handle Amphora, Zemer 41	Cyprus? Aegean?	Megaw and Hayes 2003: 479, 483, 487,	
Agora M334	1	1	1	1.2	Wine	4th AD-7th AD		N. Palestine? Jiyeh?	Megaw and Hayes 2003: 489	
Almagro 54	3	3	3	3.7	Wine	4th-7th AD	Gaza Wine Jar, Carthage LRA 4, Keay 54, Kuzmanov 14, P&W 48 and 49, Pieri LRA 4B, Zemer 53	Gaza	Megaw and Hayes 2003: 487, 494	
Beirut 2	2	2	2	2.5	Wine	1st AD			Megaw and Hayes 2003: 460	
Beltrán II	1	1	1	1.2	Fish sauce	2nd AD	Augst 27, 29, Callender 6, Camulodunum 186C, Dressel 38, P&W 18, Pélichet 46	Spain	Megaw and Hayes 2003: 479	
Dressel 21-22?	1	1	1	1.2	Fruit?	1st BC-1st AD		Italy	Megaw and Hayes 2003: 467	
Dressel 6	4	4	4	4.9	Fish sauce?	1st AD	Augst 37 or 38	Italy	Megaw and Hayes 2003: 464	One specimen stamped.
Dressel 6 LID	1	1	1	1.2					Megaw and Hayes 2003: 464	
Forlimpopoli	1	1	1	1.2	Wine? Fish sauce?	1st BC-1st AD?	Benghazi MRA 13, P&W 42	Italy	Megaw and Hayes 2003: 467	Early variant of Forlimpopoli type.

Hole-mouthed' jar	1	1	1	1.2	Unknown	Late Hell.		Tyre? Beirut region?	Megaw and Hayes 2003: 477	
Knidian?	2	2	2	2.5	Wine	2nd BC		Aegean	Megaw and Hayes 2003: 457	Possibly Cypriote imitation.
Koan?	1	1	1	1.2	Wine	2nd BC?		Cyprus? Aegean?	Megaw and Hayes 2003: 472	Came from disturbed context.
LRA 1	9	9	6	7.4	Wine and oil	3rd AD-7th AD	Ballana 6, Benghazi LRA 1, British B2, Carthage LRA 1, Keay 53, Kuzmanov 13, P&W 44, Scorpan 8B	Cilicia, Cyprus, possibly Syria	Megaw and Hayes 2003: 492	
LRA 2	2	2	2	2.5	Wine and oil	6th-7th AD	Benghazi LRA 2, British B1, Carthage LRA 2, Keay 65, Kuzmanov 19, P&W 43, Scorpan 7A	Aegean, possibly E. Med.	Megaw and Hayes 2003: 464	
LRA 5	4	4	4	4.9	Wine	6th-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Palestine	Megaw and Hayes 2003: 501	
LRA 5 variants	2	2	2	2.5	Wine	6th-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Unknown	Megaw and Hayes 2003: 501	
LRA 5/6 Cypriote	4	4	4	4.9	Wine	6th-7th AD	Palestinian bag-shaped amphora, Kellia 187, P&W 46, Pieri 1A, 2A, 3, 4A, 4B, 4D	Cyprus	Megaw and Hayes 2003: 501	
LRA 7	6	6	2	2.5	Wine	4th AD-7th/8th AD	Bailey Type B, Egloff 173, 174, 177, P&W 52B	Egypt	Megaw and Hayes 2003: 494	
Misc. Egyptian	15	15	15	18.5		Byzantine?				

Palestinian 'collar-necked' type	1	1	1	1.2	Wine?	1st AD?			Megaw and Hayes 2003: 464	Similar to LRA 5, with a different neck (see Reynolds 2013: 93).
Phoenician 'carrot' amphora	1	1	1	1.2	Unknown	1st BC-1st AD?		S. Levant	Megaw and Hayes 2003: 467	Beirut 4 probably
Rhodian	3	3	3	3.7	Wine	3rd BC-2nd AD	Augst 6, Callender 7, Camulodunum 184, Ostia 65, P&W 9	Aegean	Megaw and Hayes 2003: 464	One with stamped handle.
Sidon 3/Beirut 1	1	1	1	1.2	Wine?	late 2nd BC-1st AD		Beirut	Megaw and Hayes 2003: 467	Definitely from Beirut, identification of type tentative.
Spatheion	1	1	1	1.2	Unknown	4th AD-5th AD	Benghazi LRA 8, Keay 26, P&W 51	N. Africa	Megaw and Hayes 2003: 487	
Tripolitanian	1	1	1	1.2	Olive oil? Wine or fish sauce?	2nd AD-3rd AD	Ostia 64, P&W 36	N. Africa	Megaw and Hayes 2003: 477	
Unidentified	6	6	5	6.2	Unknown	Unknown		Unknown	Megaw and Hayes 2003: 479, 483 (Sinopean, see publication for parallel), 487 (Palestinian), 489 (Sinopean carrot-shaped), 494 (Egyptian?)	
Unidentified (Cypriot)	12	12	9	11.1	Unknown	Unknown		Cyprus	Megaw and Hayes 2003: 480, 497, 502	
Unidentified N. African	5	5	1	1.2	Unknown	Unknown		N. Africa	Megaw and Hayes 2003: 483	
Total	**100**	**100**	**81**	**100.0**						

Table 10.19: Saranda Kolones Castle excavations amphora frequencies

Theatre in Paphos	***Sherds (diagnostics)***	***% of total sherds (from respective period)***	***Other Names***	***Source***	***Reference***
Beirut 3	2	0.8		Beirut	Kaldeli 2013b: 411, Table 3.3.2.2.2
Beirut 8	4	0.9		Beirut	Kaldeli 2013b: 448, Table 3.3.4.2.2
Hayes II	1	0.4		Lebanon?	Kaldeli 2013b: 411, Table 3.3.2.2.2

Table 10.20: Beirut amphorae in Theatre excavations at Paphos

House of Orpheus	***Sherd Count***	***% of total sherds***	***Reference***
Agora K114	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. I	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. IIA	5	1.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. IIB	6	1.3	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. III	8	1.7	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. IVA	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beltr. IVB	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Cl. 16	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Cretan 1	5	1.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 16	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 20	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 21-22	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 2-4 92	92	19.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)

Dr. 2-4 imitations 2	29	6.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 2-4 or MRCA	7	1.5	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Dr. 28?	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Gaul. 1	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Gaul. 4	52	10.9	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Gaul. 5	4	0.8	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Gauloise 1	15	3.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes I	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes II (Local?)	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes II (unclear?)	16	3.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Beirut 3	9	1.9	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes V	7	1.5	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes VI	31	6.5	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes VII	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes VIII	15	3.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Hayes X	50	10.5	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Mañá C	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
N. African	4	0.8	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Pamphylian	4	0.8	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos I	10	2.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos II	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos III	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos VI	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos VII	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos VIII	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos IX	5	1.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Paphos X	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Pinched-handle amph.	23	4.8	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Pompeii V	5	1.1	(Kaldeli 2013b: 408, Table 3.3.2.1.2)

Pseudo-Cos en cloche 2	20	4.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
`Rhodian'	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Sub-Koan IIB	1	0.2	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Sub-Koan IV	2	0.4	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Tripol. I	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Tripol. II	3	0.6	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Tripol. III	4	0.8	(Kaldeli 2013b: 408, Table 3.3.2.1.2)
Total:	**475**	**100.0**	

Table 10.21: Amphora frequencies from House of Orpheus, Paphos

D.1.12 Salamis

Agora	***MNI***	***% of total MNI (excluding Hell. period)***	***Reference***	***Notes***
Beirut 8	3	4.0	Diederichs 1980: Pl. 20.207-210	

Table 10.22: Beirut amphorae observed at Salamis

D.1.13 Tel Anafa

Tel Anafa	***Sherds (rims)***	***% of total sherds (rims)***	***Sherds (total)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***
Beirut 2/Jiyeh 6	14	2.5	14	2.2			Wine	1st AD		Probably Jiyeh	Berlin 1997: Pl. 61:PW 501
Pie-crust rim baggy jar'	23	4.1	23	3.6			Unknown	1st AD			Berlin 1997: Fig. 38
Other baggy jars'	5	0.9	5	0.8			Unknown	1st AD			Berlin 1997: Fig. 38
Galilean high-necked jar'	2	0.4	2	0.3			Unknown	1st AD			Berlin 1997: Fig. 38
Galilean droppy lip jar'	2	0.4	2	0.3			Unknown	1st AD		Similar to Sidonian form	Berlin 1997: Fig. 38

Puffy rim jar'	278	49.9	278	43.2			Unknown	1st AD			Berlin 1997: Fig. 38
Ridged neck jar'	233	41.8	233	36.2			Unknown	1st AD			Berlin 1997: Fig. 38
Rhodian			18	2.8	5	10.9		1st BC-1st AD	Augst 6, Callender 7, Camulodunum 184, Ostia 65, P&W 9		Berlin 1997: 163
Rhodian Imitation			15	2.3	4	8.7		1st BC-1st AD?			Berlin 1997: 163
Min. Koan Imitation			1	0.2	1	2.2		1st BC-1st AD?			Berlin 1997: 163
Knidian			2	0.3	2	4.3		1st BC-1st AD?			Berlin 1997: 164
Dressel 1A			4	0.6	2	4.3	Wine	2nd BC-1st BC			Berlin 1997: 164
Dressel 1B			5	0.8	1	2.2	Wine. Possibly other foodstuffs.	2nd BC-1st BC			Berlin 1997: 164
Lamboglia 2			2	0.3	2	4.3	Olive oil or wine	1st AD	Apani 1, Baldacci 1, P&W 8		Berlin 1997: 164
Dressel 2-4			1	0.2	1	2.2	Wine	1st BC-1st AD	Camulodunum 182/183, Koan Amphora, P&W 10		Berlin 1997: 164
Unidentified (non-Beirut)			39	6.1	28	60.9	Unknown	Unknown			Berlin 1997: 164-66
Total	**557**	**100.0**	**644**	**100**	**46**	**100**					

Table 10.23: Amphora frequencies from Tel Anafa

D.1.14 Yavneh-Yam

Courthouse Site and the Hospitaller Compound (Hellenistic-Early Roman)	***Sherds (diagnostics)***	***% of total sherds***	***MNI***	***% of total MNI***	***Product***	***Date***	***Other Names***	***Source***	***Reference***	***Notes***
Africana Grande II?	1	0.05	1.00	0.05	Unknown	2nd AD-end of 3rd AD	Keay 4, 5, 6, 7	N. Africa	Jakoel 2015: 38-39	
Crétoise 3? Sidon 3/Beirut 1A?	1	0.05	1.00	0.05	Wine?	1st AD-3rd AD		Crete	Jakoel 2015: 38-39	Could possibly be a Sidon 3/Beirut 1 amphora. Handle and ware match, but Sidon/Beirut has a more straight-walled neck.
Dressel 6	1	0.05	1.00	0.05	Fish sauce?	1st BC-1st AD	Augst 37, 38	Spain	Jakoel 2015: 38-39	
Paphos V	1	0.05	1.00	0.05	Unknown	2nd AD?		Unknown	Jakoel 2015: 38-39	
Storage Jars	16	0.76	16.00	0.76	Unknown	1st AD-3rd AD?		Southern Levant?	Jakoel 2015: 38-39	Late form of 'Baggy Jar' from southern Levant. Seem to be local products from kiln.

Unidentified	1	0.05	1.00	0.05	Unknown	Unknown		Unknown	Jakoel 2015: 38-39	Possibly Aegean or from Asia Minor, Fig. 7.2
Total	**21**	**100**	**21**	**100**						

Table 10.24: Amphora frequencies from Yavneh Yam from Hellenistic-Early Roman period

Appendix E **Regression Analysis: Distance**

E.1 All Data

Site	Context	Distance from Beirut (n miles)	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7	Type 8
Jiyeh		17	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0
Akko		78	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.4
Dor		98	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Caesarea	*Harbour*	105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
	Area LL	105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Vault 1	105	0.0	0.0	5	0.0	0.0	0.0	0.0	0.0
	Late Byzantine Building	105	0.0	0.0	0.0	0.0	0.08	0.0	0.0	1.5
Apollonia		133	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0
Salamis		135	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
Jaffa		144	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amathous	*Agora (early)*	154	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0
	Agora (late)	154	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
	Palaea Lemesos	154	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
Yavneh-Yam		154	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kourion	*Early*	170	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
	Late	170	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Antioch		172	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ashkelon		173	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Paphos	*SK Castle*	196	1.0	2.0	1.0	0.0	0.0	0.0	0.0	0.3
	House of Orpheus	196	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0

	Theatre (early)	196	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
	Theatre (late)	196	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9

E.2 Type 2

E.2.1 Presence/Absence, Logistic Regression

Statistic	Independent	Full
Observations	19	19
Sum of weights	19.000	19.000
DF	18	17
-2 Log(Likelihood)	23.699	21.328
R^2(McFadden)	0.000	0.100
R^2(Cox and Snell)	0.000	0.117
R^2(Nagelkerke)	0.000	0.165
AIC	25.699	25.328
SBC	26.643	27.217
Iterations	0	12

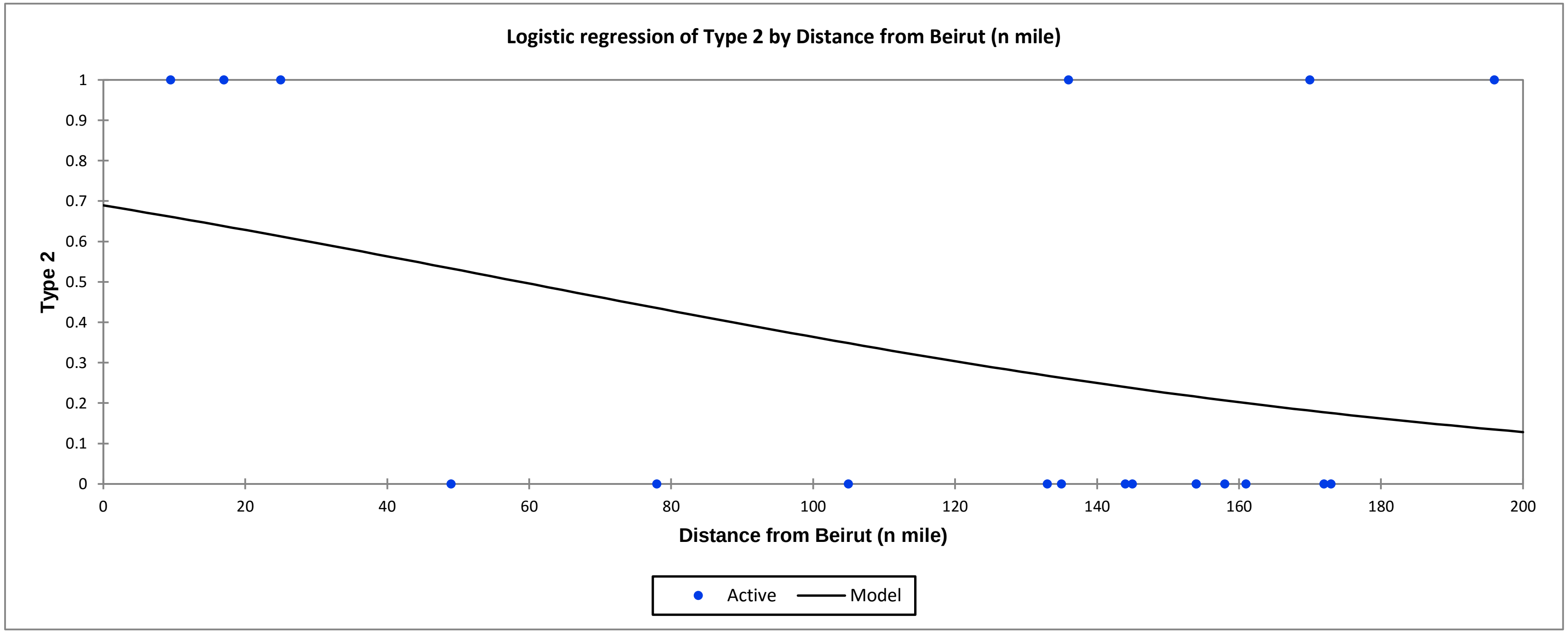
Test of the null
hypothesis H0: Y=0.316
(Variable Type 2):

Statistic	DF	Chi-square	Pr > Chi^2
-2 Log(Likelihood)	1	2.371	0.124
Score	1	2.432	0.119

Wald	1	2.189	0.139

Type II analysis
(Variable Type 2):

Source	DF	Chi-square (Wald)	Pr > Wald	Chi-square (LR)	Pr > LR
Distance from Beirut (n mile)	1	2.189	0.139	2.371	0.124



E.2.2 Frequency, Regression

Regression Statistics	
Multiple R	0.625167077
R Square	0.390833874
Adjusted R Square	0.358772499
Standard Error	6.974424865
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	592.9619869	592.9619869	12.19017816	0.002442306
Residual	19	924.2094416	48.64260219		
Total	20	1517.171429			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	19.30061109	5.171874393	3.731840649	0.001413322	8.475753581	30.1254686	8.475753581	30.1254686
X Variable 1	-0.120322986	0.034462246	-3.491443564	0.002442306	-0.192453295	-0.048192677	-0.192453295	-0.048192677

Observation	*Predicted Y*	*Residuals*
1	17.25512033	22.74487967
2	9.915418207	-9.915418207
3	6.666697593	-6.666697593
4	6.666697593	-6.666697593
5	6.666697593	-6.666697593
6	6.666697593	-6.666697593
7	3.297653994	-3.297653994
8	3.057008022	-3.057008022

9	1.974101151	-1.974101151
10	0.770871294	-0.770871294
11	0.770871294	-0.770871294
12	0.770871294	-0.770871294
13	0.770871294	-0.770871294
14	-1.154296477	2.054296477
15	-1.154296477	1.154296477
16	-1.394942449	1.394942449
17	-1.515265434	1.515265434
18	-4.282694105	6.282694105
19	-4.282694105	4.282694105
20	-4.282694105	4.282694105
21	-4.282694105	4.282694105

E.3 Type 3

E.3.1 Presence/Absence, Logistic Regression

Statistic	Independent	Full
Observations	19	19
Sum of weights	19.000	19.000
DF	18	17
-2 Log(Likelihood)	23.699	23.694
R^2(McFadden)	0.000	0.000
R^2(Cox and Snell)	0.000	0.000
R^2(Nagelkerke)	0.000	0.000
AIC	25.699	27.694

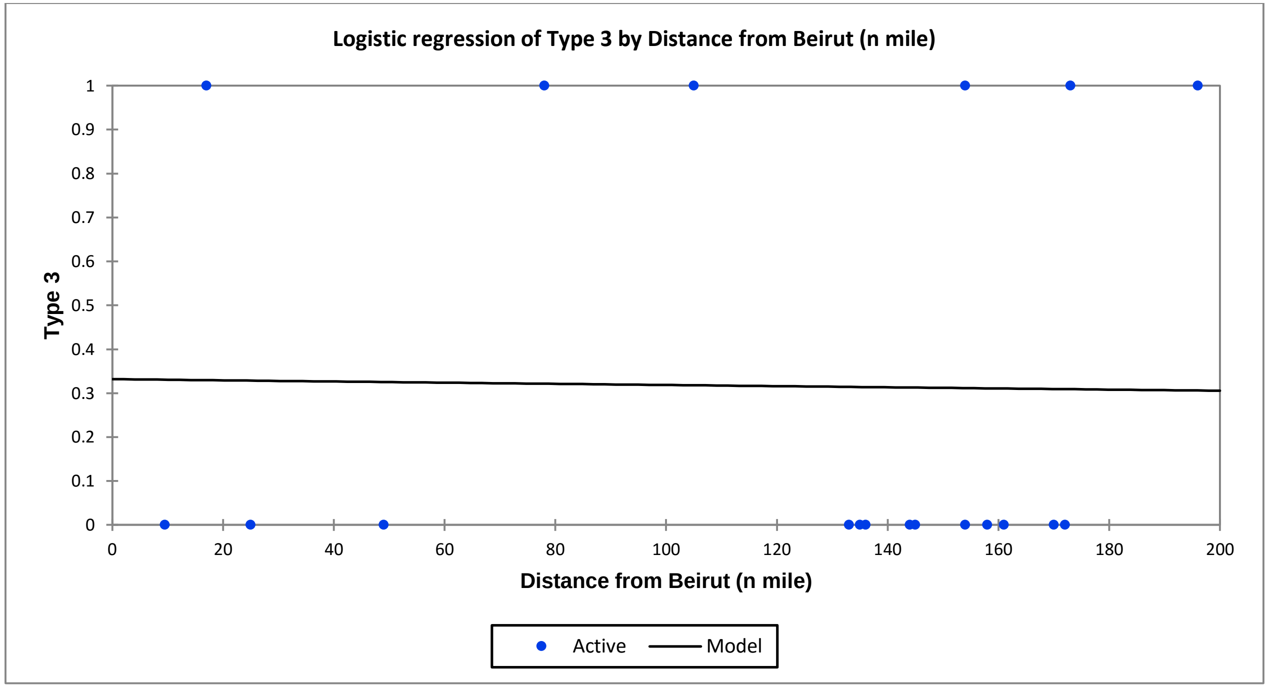
SBC	26.643	29.583
Iterations	0	10

Test of the null hypothesis H0: Y=0.316 (Variable Type 3):

Statistic	DF	Chi-square	Pr > Chi²
-2 Log(Likelihood)	1	0.005	0.945
Score	1	0.005	0.945
Wald	1	0.005	0.945

Type II analysis (Variable Type 3):

Source	DF	Chi-square (Wald)	Pr > Wald	Chi-square (LR)	Pr > LR
Distance from Beirut (n mile)	1	0.005	0.945	0.005	0.945



E.3.2 Frequency, Regression

Regression Statistics	
Multiple R	0.022117757
R Square	0.000489195
Adjusted R Square	-0.052116637
Standard Error	1.402518201
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.018292172	0.018292172	0.009299257	0.924186864
Residual	19	37.37408878	1.967057304		
Total	20	37.39238095			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.585099872	1.040035288	0.562576942	0.580300942	-1.591719002	2.761918746	-1.591719002	2.761918746
X Variable 1	0.000668294	0.006930167	0.096432657	0.924186864	-0.013836711	0.0151733	-0.013836711	0.0151733

Observation	*Predicted Y*	*Residuals*
1	0.596460877	-0.596460877
2	0.637226834	-0.037226834
3	0.655270782	-0.655270782
4	0.655270782	-0.655270782
5	0.655270782	4.344729218
6	0.655270782	-0.655270782
7	0.673983025	-0.673983025
8	0.675319614	-0.675319614
9	0.681334263	-0.681334263
10	0.688017207	3.311982793
11	0.688017207	-0.688017207
12	0.688017207	-0.288017207
13	0.688017207	-0.688017207
14	0.698709917	-0.698709917
15	0.698709917	-0.698709917
16	0.700046506	-0.700046506
17	0.700714801	-0.100714801
18	0.716085571	0.283914429
19	0.716085571	1.183914429

20	0.716085571	0.083914429
21	0.716085571	-0.716085571

E.4 Type 8

E.4.1 Presence/Absence, Logistic Regression

Statistic	Independent	Full
Observations	19	19
Sum of weights	19.000	19.000
DF	18	17
-2 Log(Likelihood)	23.699	22.738
R^2(McFadden)	0.000	0.041
R^2(Cox and Snell)	0.000	0.049
R^2(Nagelkerke)	0.000	0.069
AIC	25.699	26.738
SBC	26.643	28.627
Iterations	0	12

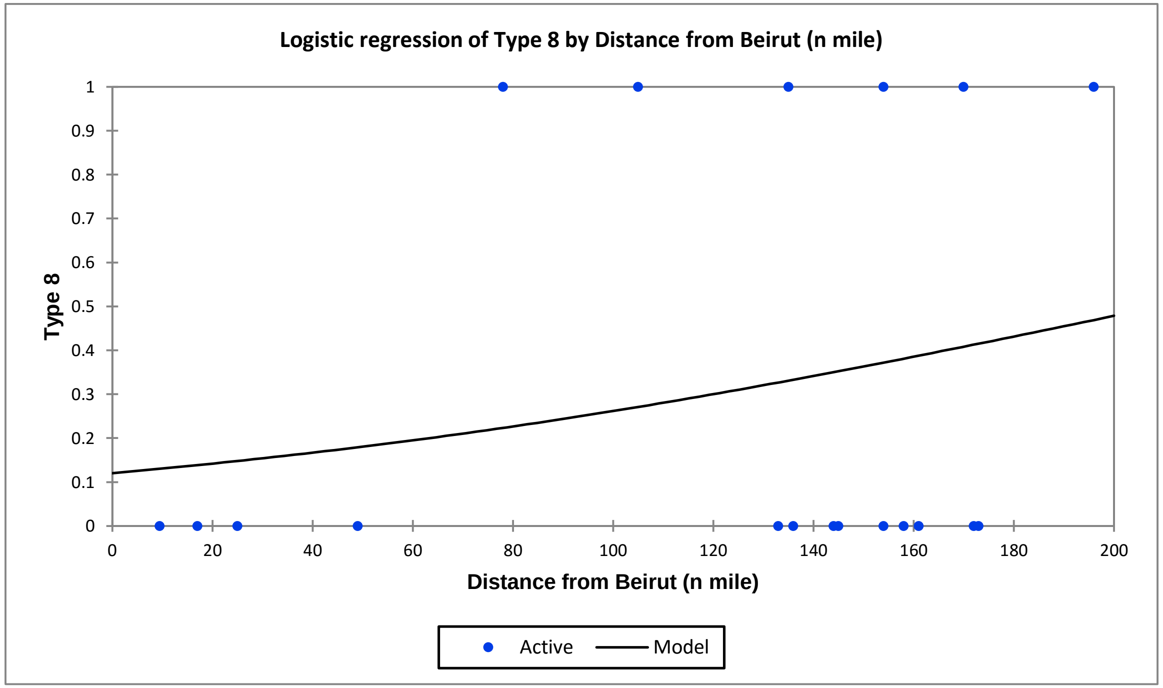
Test of the null hypothesis H0: Y=0.316 (Variable Type 8):

Statistic	DF	Chi-square	Pr > Chi²
-2 Log(Likelihood)	1	0.961	0.327
Score	1	0.887	0.346

Wald	1	0.832	0.362

Type II analysis
(Variable Type 8):

Source	DF	Chi-square (Wald)	Pr > Wald	Chi-square (LR)	Pr > LR
Distance from Beirut (n mile)	1	0.832	0.362	0.961	0.327



E.4.2 Frequency, Regression

Regression Statistics	
Multiple R	0.0297732
R Square	0.000886443
Adjusted R Square	-0.051698481
Standard Error	1.04712501
Observations	21

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.018483612	0.018483612	0.016857368	0.898060937
Residual	19	20.83294496	1.096470787		
Total	20	20.85142857			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.65349564	0.776493995	0.841597803	0.410481143	-0.97172497	2.27871625	-0.97172497	2.27871625
X Variable 1	-0.000671782	0.005174087	-0.129835927	0.898060937	-0.01150127	0.010157706	-0.01150127	0.010157706

Observation	*Predicted Y*	*Residuals*
1	0.64207534	-0.64207534
2	0.601096617	-0.201096617
3	0.582958493	0.317041507
4	0.582958493	-0.582958493
5	0.582958493	-0.582958493
6	0.582958493	0.917041507
7	0.564148587	-0.564148587
8	0.562805023	3.437194977

9	0.556758982	-0.556758982
10	0.550041158	-0.550041158
11	0.550041158	1.749958842
12	0.550041158	-0.550041158
13	0.550041158	-0.550041158
14	0.53929264	-0.53929264
15	0.53929264	0.86070736
16	0.537949076	-0.537949076
17	0.537277293	-0.537277293
18	0.521826299	-0.221826299
19	0.521826299	-0.521826299
20	0.521826299	-0.521826299
21	0.521826299	0.378173701

Appendix F **Average, Median, Range and Standard Deviation of Assemblages: Sources**

F.1 Frequency of Imports Based on Amphora Source

Site	Context	Cen/N. Levant (1)	Cilicia/ Asia Minor (2)	Cyprus (3)	Egypt (4)	Gaul (5)	Greece (6)	Italy (7)	North Africa (8)	S. Levant (9)	Spain (10)	W. Med (11)	Beirut 1 %	Beirut 2 %	Beirut 3 %	Beirut 4 %	Beirut 5 %	Beirut 6 %	Beirut 7 %	Beirut 8 %
Amathous	*Agora (early)*	7	17.5	12.9	0.6	11.1	11.1	5.8	9.9	0	23.4	0.6	0	0	4	0	0	0	0	0
	Agora (late)	2.3	6.8	63.5	2.6	0	2.6	0	6	16.1	0	0	0	0	0	0	0	0	0	2.3
	Palaea Lemesos	2.3	2.4	62	6.7	0	7.3	0	4.6	14.7	0	0	0	0	0.4	0	0	0	0	0
Apollonia	*Harbour*	4.5	4.5	0	0	0	0	0	4.5	86.4	0	0	0	0	0	0	4.5	0	0	0

Ashkelon	*1995-1998, varied*	0.8	24.2	0	14.5	0.8	17.7	7.3	24.2	0	3.2	7.3	0	0	0.8	0	0	0	0	0
Caesarea	*Harbour*	1.7	6.8	0	0	3.4	35.6	1.7	5.1	27.1	15.3	3.4	0	0	0	0	0	0	0	1.7
	Area LL	0	5.7	0	7	0	8.9	0	0	78.5	0	0	0	0	0	0	0	0	0	0
Kourion	*General (early)*	3.1	25.8	51.2	1.6	0.3	9	0.6	5.3	0	2.5	0.6	0	0.9	0	0	0	0	0	0
	General (late)	2.3	4.5	60.2	5.1	0	2.8	0	5.9	19.2	0	0	0	0	0	0	0	0	0	1.4
Paphos	*SK Castle*	5.4	9.8	17.4	22.8	0	18.5	6.5	7.6	9.8	2.2	0	1.1	2.2	0.0	1.1	0.0	0.0	0.0	0.0
	House of Orpheus	5.5	17.9	23.6	0.4	16.4	3.4	17.7	3.4	0	8.8	2.5	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0
	Theatre (early)	2.7	15.3	58.8	6.7	1.2	8.2	1.6	4.7	0	0.8	0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0
	Theatre (late)	2.8	5.4	49.8	11.3	0	6.1	0	3.5	21.1	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9

F.2 Statistical Indices of Frequency of Imports Based on Source

Site	Context	Average	Median	Standard Deviation	Range	Beirut 1 %	Beirut 2 %	Beirut 3 %	Beirut 4 %	Beirut 5 %	Beirut 6 %	Beirut 7 %	Beirut 8 %	Primary Source
Amathous	*Agora (early)*	10.0	10.5	6.7	22.8	0	0	4	0	0	0	0	0	Spain
	Agora (late)	14.3	6.0	20.6	61.3	0	0	0	0	0	0	0	2.3	Cyprus
	Palaea Lemesos	14.3	6.7	19.9	59.7	0	0	0.4	0	0	0	0	0	Cyprus
Antioch	*Photo Archives*	16.7	15.6	14.0	34.4	0.0	0	0	0	0	0	0	0	Cilicia/Asia Minor
Apollonia	*Harbour*	25.0	4.5	35.4	81.9	0	0	0	0	3.4	0	0	0	Southern Levant
Ashkelon	*1995-1998, varied*	6.1	4.0	10.2	23.4	0	0	0.6	0	0	0	0	0	Misc. (imports only)
Caesarea	*Harbour*	11.1	5.1	11.6	33.9	0	0	0	0	0	0	0	0.9	Greece and Southern Levant
	Area LL	25.0	7.9	30.9	72.8	0	0	0	0	0	0	0	0	Southern Levant

Kourion	*General (early)*	10.0	2.8	15.6	40.9	0	0.9	0	0	0	0	0	0	Cyprus
	General (late)	14.3	5.1	19.5	57.9	0	0	0	0	0	0	0	1.4	Cilicia/Asia Minor/Cyprus
Paphos	*SK Castle*	11.1	9.8	6.5	20.6	1.2	2.5	0.0	1.2	0.0	0.0	0.0	0.0	Egypt
	House of Orpheus	9.1	5.5	7.9	23.2	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	Cyprus
	Theatre (early)	11.1	4.7	17.4	58.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	Cyprus
	Theatre (late)	14.3	6.1	15.6	47.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	Southern Levant

Appendix G **Regression Analysis: Statistical Indices Based on Source**

G.1 Type 2

Regression Statistics	
Multiple R	0.451467805
R Square	0.203823179
Adjusted R Square	-0.150033186
Standard Error	0.742637476
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1.270691933	0.317672983	0.576005406	0.687402773
Residual	9	4.963593781	0.55151042		
Total	13	6.234285714			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.812656221	0.807459272	1.006436175	0.340496433	-1.013943555	2.639255997	-1.013943555	2.639255997
X Variable 1	0.131849318	0.154471291	0.853552251	0.415492074	-0.21758902	0.481287656	-0.21758902	0.481287656
X Variable 2	-0.076623832	0.117004976	-0.654876695	0.528927019	-0.341307475	0.188059812	-0.341307475	0.188059812
X Variable 3	-0.094947659	0.153897394	-0.616954303	0.552550445	-0.443087751	0.253192432	-0.443087751	0.253192432
X Variable 4	-0.006461786	0.039640427	-0.163009996	0.874112085	-0.096134661	0.083211089	-0.096134661	0.083211089

Observation	*Predicted Y*	*Residuals*
1	0.542086912	-0.542086912
2	-0.113643493	0.113643493
3	-0.086749597	0.086749597
4	0.271238727	-0.271238727
5	-0.128973423	0.128973423
6	0.195048166	-0.195048166
7	0.564121847	-0.564121847
8	0.099468075	-0.099468075
9	0.175804465	0.724195535
10	0.08393184	-0.08393184
11	0.77527288	1.72472712
12	0.690756819	-0.690756819
13	-0.112206487	0.112206487
14	0.443843268	-0.443843268

G.2 Type 3

Regression Statistics	
Multiple R	0.469456156
R Square	0.220389082
Adjusted R Square	-0.126104659
Standard Error	1.196795096
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	3.644133474	0.911033368	0.636055016	0.649659243
Residual	9	12.89086653	1.432318503		
Total	13	16.535			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.288071587	1.30125846	0.989866062	0.348103936	-1.655579558	4.231722732	-1.655579558	4.231722732
X Variable 1	-0.009892945	0.248937725	-0.039740644	0.969167503	-0.573029204	0.553243313	-0.573029204	0.553243313
X Variable 2	0.037836226	0.188559002	0.200659874	0.845425798	-0.388713871	0.464386322	-0.388713871	0.464386322
X Variable 3	-0.052324854	0.248012863	-0.210976374	0.837605298	-0.613368928	0.508719219	-0.613368928	0.508719219
X Variable 4	0.000196582	0.063882405	0.00307724	0.997611851	-0.144315459	0.144708622	-0.144315459	0.144708622

Observation	*Predicted Y*	*Residuals*
1	1.239758081	2.760241919
2	0.307793295	-0.307793295
3	0.372646188	0.027353812
4	0.989293698	-0.989293698

5	-0.626670172	0.626670172
6	0.852313772	-0.252313772
7	0.770461451	-0.770461451
8	-0.262758196	0.262758196
9	0.48943089	-0.48943089
10	0.331842821	-0.331842821
11	1.21314467	-1.21314467
12	0.997175588	0.902824412
13	0.456275993	0.343724007
14	0.56929192	-0.56929192

G.3 Type 8

Regression Statistics	
Multiple R	0.514484503
R Square	0.264694304
Adjusted R Square	-0.062108228
Standard Error	0.740373479
Observations	14

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	1.775909713	0.443977428	0.809951816	0.54925335
Residual	9	4.933376002	0.548152889		
Total	13	6.709285714			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.103235207	0.804997661	-0.128242866	0.900776703	-1.924266432	1.717796018	-1.924266432	1.717796018
X Variable 1	0.049938089	0.154000372	0.324272524	0.75314126	-0.298434955	0.398311133	-0.298434955	0.398311133
X Variable 2	-0.04763607	0.116648276	-0.408373548	0.69254464	-0.311512802	0.216240662	-0.311512802	0.216240662
X Variable 3	-0.169981286	0.153428224	-1.107887986	0.296638594	-0.517060042	0.17709747	-0.517060042	0.17709747
X Variable 4	0.064615188	0.039519579	1.63501711	0.136475613	-0.024784311	0.154014688	-0.024784311	0.154014688

Observation	*Predicted Y*	*Residuals*
1	0.228467087	-0.228467087
2	0.784408422	1.515591578
3	0.773340516	-0.773340516
4	-0.162952246	0.162952246
5	0.200688932	-0.200688932
6	-0.203311499	0.203311499
7	0.425314514	0.474685486
8	0.220828126	-0.220828126
9	0.262182494	-0.262182494
10	0.798509722	0.601490278
11	0.210931561	-0.210931561
12	0.244891186	-0.244891186
13	1.01471457	-1.01471457
14	0.701986615	0.198013385

Appendix H Regression Analysis: Frequency of Imports Based on Source

H.1 Type 2

Regression Statistics	
Multiple R	0.995234393
R Square	0.990491496
Adjusted R Square	0.885897955
Standard Error	0.213838559
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	4.763329345	0.43302994	9.469910745	0.248690488
Residual	1	0.045726929	0.045726929		
Total	12	4.809056275			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-183.3367082	338.0257982	-0.542374899	0.683618967	-4478.361706	4111.68829	-4478.361706	4111.68829
X Variable 1	1.899758866	3.462295961	0.548699154	0.68051623	-42.09288248	45.89240021	-42.09288248	45.89240021
X Variable 2	1.853823059	3.371392638	0.549868632	0.679944281	-40.98378204	44.69142816	-40.98378204	44.69142816
X Variable 3	1.853520238	3.385479944	0.547491129	0.681107623	-41.16308106	44.87012154	-41.16308106	44.87012154
X Variable 4	1.82216098	3.35859413	0.54253682	0.683539322	-40.85282366	44.49714562	-40.85282366	44.49714562
X Variable 5	0.981799016	3.311707903	0.296463047	0.816520622	-41.09743963	43.06103766	-41.09743963	43.06103766
X Variable 6	1.733691793	3.352015106	0.517208825	0.696128842	-40.85769842	44.32508201	-40.85769842	44.32508201
X Variable 7	2.460671865	3.494005832	0.704255225	0.609385313	-41.93488159	46.85622532	-41.93488159	46.85622532

X Variable 8	1.630899549	3.355415473	0.486049958	0.71197703	-41.00369643	44.26549553	-41.00369643	44.26549553
X Variable 9	1.841599994	3.381800348	0.54456201	0.682544085	-41.1282476	44.81144759	-41.1282476	44.81144759
X Variable 10	2.171563184	3.41030086	0.636765867	0.639026748	-41.16041776	45.50354413	-41.16041776	45.50354413
X Variable 11	2.010388817	3.497779727	0.574761412	0.66790414	-42.43311652	46.45389415	-42.43311652	46.45389415

Observation	*Predicted Y*	*Residuals*
1	-0.012222762	0.012222762
2	0.017643582	-0.017643582
3	-0.161746148	0.161746148
4	0.007697956	-0.007697956
5	-0.005750623	0.005750623
6	0.024751625	-0.024751625
7	-0.019333372	0.019333372
8	0.849950848	0.050049152
9	0.085244595	-0.085244595
10	2.173599005	0.000314039
11	-0.001925131	0.001925131
12	0.085587103	-0.085587103
13	0.030416366	-0.030416366

H.2 Type 3

Regression Statistics	
Multiple R	0.999998832
R Square	0.999997664
Adjusted R Square	0.999971963
Standard Error	0.001596281

Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	1.09058928	0.09914448	38908.99108	0.003954178
Residual	1	2.54811E-06	2.54811E-06		
Total	12	1.090591828			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	7.762642667	2.523324544	3.076355234	0.200080781	-24.2992356	39.82452093	-24.2992356	39.82452093
X Variable 1	-0.079286665	0.02584565	-3.067698666	0.200608784	-0.407686782	0.249113452	-0.407686782	0.249113452
X Variable 2	-0.081904647	0.025167067	-3.254437545	0.189786299	-0.401682548	0.237873255	-0.401682548	0.237873255
X Variable 3	-0.075347035	0.025272227	-2.981416555	0.206022455	-0.396461123	0.245767052	-0.396461123	0.245767052
X Variable 4	-0.076973444	0.025071527	-3.07015377	0.200458763	-0.395537402	0.241590514	-0.395537402	0.241590514
X Variable 5	-0.298133097	0.024721527	-12.05965552	0.052668722	-0.612249878	0.015983684	-0.612249878	0.015983684
X Variable 6	-0.085713167	0.025022416	-3.425455324	0.180824599	-0.403653101	0.232226768	-0.403653101	0.232226768
X Variable 7	0.108096877	0.02608236	4.144443825	0.150727011	-0.223310933	0.439504688	-0.223310933	0.439504688
X Variable 8	-0.097713369	0.025047799	-3.901076056	0.159751024	-0.41597583	0.220549093	-0.41597583	0.220549093
X Variable 9	-0.076360117	0.025244759	-3.0247909	0.203266181	-0.397125194	0.244404959	-0.397125194	0.244404959
X Variable 10	-0.002194271	0.025457512	-0.086193464	0.945262822	-0.325662633	0.32127409	-0.325662633	0.32127409
X Variable 11	-0.172991969	0.026110532	-6.625371264	0.095368307	-0.504757735	0.158773797	-0.504757735	0.158773797

Observation	*Predicted Y*	*Residuals*
1	-9.12415E-05	9.12415E-05
2	0.000131707	-0.000131707
3	-0.001207417	0.001207417
4	5.74644E-05	-5.74644E-05
5	-4.29278E-05	4.29278E-05
6	0.000184768	-0.000184768

7	-0.000144321	0.000144321
8	-0.000373611	0.000373611
9	0.000636341	-0.000636341
10	1.086954177	2.34426E-06
11	-1.43709E-05	1.43709E-05
12	0.000638898	-0.000638898
13	0.000227055	-0.000227055

H.3 Type 8

Regression Statistics	
Multiple R	0.923768706
R Square	0.853348623
Adjusted R Square	-0.759816526
Standard Error	1.077609892
Observations	13

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	11	6.757148835	0.614286258	0.528990242	0.803484891
Residual	1	1.161243079	1.161243079		
Total	12	7.918391914			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1335.515886	1703.434334	0.784013719	0.576700746	-20308.66952	22979.70129	-20308.66952	22979.70129
X Variable 1	-13.90651966	17.44776241	-0.797037427	0.571598258	-235.601361	207.7883217	-235.601361	207.7883217
X Variable 2	-13.37264784	16.98966766	-0.787104734	0.575483877	-229.2468436	202.5015479	-229.2468436	202.5015479

X Variable 3	-13.29090496	17.0606587	-0.779038207	0.578667188	-230.0671273	203.4853174	-230.0671273	203.4853174
X Variable 4	-13.28900687	16.92517135	-0.785162324	0.576248137	-228.3436992	201.7656855	-228.3436992	201.7656855
X Variable 5	-14.66852555	16.68889469	-0.878939308	0.540961009	-226.7210383	197.3839872	-226.7210383	197.3839872
X Variable 6	-13.51561054	16.89201727	-0.800118205	0.570400692	-228.1490403	201.1178193	-228.1490403	201.1178193
X Variable 7	-12.7154717	17.60755993	-0.722159786	0.60182998	-236.440733	211.0097896	-236.440733	211.0097896
X Variable 8	-13.70258575	16.90915295	-0.810365001	0.566443353	-228.553745	201.1485735	-228.553745	201.1485735
X Variable 9	-13.32334247	17.04211588	-0.781789219	0.577578748	-229.863956	203.2172711	-229.863956	203.2172711
X Variable 10	-12.59921687	17.18574028	-0.733120405	0.597267739	-230.9647514	205.7663176	-230.9647514	205.7663176
X Variable 11	-12.65053073	17.62657795	-0.717696354	0.603701491	-236.6174389	211.3163775	-236.6174389	211.3163775

Observation	*Predicted Y*	*Residuals*
1	0.061594923	-0.061594923
2	2.211087603	0.088912397
3	0.815097378	-0.815097378
4	-0.038792786	0.038792786
5	0.028979472	-0.028979472
6	1.570182857	0.124732398
7	0.097427858	-0.097427858
8	0.25221579	-0.25221579
9	0.970421636	0.429578364
10	0.001582555	-0.001582555
11	0.00970143	-0.00970143
12	-0.431304387	0.431304387
13	0.785688062	0.153279075