



## Architecture and storage in Mediterranean environments: Case studies from the Aegean and southern California

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### ABSTRACT

This paper offers a comparative look at the organization of built space and storage for sedentary communities in the world's Mediterranean climatic regions and assesses the variable expressions of certain underlying features that are held in common. Our analysis focuses on two primary case studies: the occupants of the Aegean Sea region from the Neolithic to Roman periods (ca. 6800 BCE–168 CE) and the coastal Chumash of southern California during the Late Period (1300–1782 CE). We show that in both regions, households took advantage of outdoor spaces as productive activity areas during the long periods of favorable weather each year. This incorporation of exterior spaces was typically structured using clear visual cues or architecture. Additionally, surplus food was acquired by individual households and stored to mitigate the inherent risks of interannual variability in precipitation and expected annual periods of lower yield (i.e., winter). Since storage was typically organized at the household level, the domestic architecture often incorporated dedicated space or built facilities to manage this surplus. By understanding such climatic influences on the regions' architecture and storage infrastructure, the distinct cultural qualities of these expressions can be better articulated. While it is not our contention that these attributes manifested identical outward architectural and material forms or were exclusive to Mediterranean environments, we suggest that the environment was an important influence on construction and storage decisions which could be adapted according to the local histories of their respective communities.

### 1. Introduction

Although situated in similar climates, the archaeologies of the world's five Mediterranean regions demonstrate considerable variability. In the Mediterranean Basin, for instance, agriculture was adopted relatively early and complex societies, including the Roman Empire and Egyptian Kingdom, came to control extensive territories. In southern California and southwestern Australia, in contrast, the inhabitants remained hunter-gathers until the time of European contact. This paper considers the distinctly cultural influences on this variability in relation to the regions' household architecture and storage while responding to the theme of this special edition, Human Adaptations in Mediterranean Environments. Our central goals are twofold: 1) identify similar characteristics in aspects of household architecture and organization that may be attributed as responses to the Mediterranean environment; and 2) consider their different expressions to determine how local histories affected the appearance and outward forms of these adaptations. In doing so, our approach rejects a deterministic role for the environment

and treats the Mediterranean habitat as a complementary, but essential, influence on vernacular construction and domestic organization.

To meet these goals, a cross-cultural and diachronic comparison of two Mediterranean regions is presented: (1) coastal southern California and (2) the Greek mainland and islands that border the Aegean Sea (Fig. 1). Both regions have long histories of study and, therefore, extensive records of archaeological publication. They also present very different cultural systems, with (1) an example of complex hunter-gatherers at the time of contact with the Spanish explorers and (2) an example of a complex agricultural population. For the former, we consider the architecture from the Late Period (1300–1782 CE; Arnold, 1992), a period with clearly identifiable house structures in the archaeological record and available ethnographic data to supplement the archaeology. Because of the abundant architectural remains in the Aegean, the second case study incorporates a much longer duration, the Neolithic to Roman Periods (ca. 6800–168 BCE).

Our analysis was successful in identifying some shared structuring features among sedentary groups that reflect adaptations to the

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Mediterranean climate. Specifically, we argue that these include the organization of storage at the household scale and a close relationship between interior space and specific exterior activity areas. Although these features are not necessarily unique to Mediterranean environments and their outward form/design varies considerably even within the case studies, a recognition that such underlying qualities are adaptations within the climatic realities of the Mediterranean will help to sharpen future architectural analyses, especially those focusing on human behavior and architecture (Rapoport, 1977, 1990), and clarify the distinctly cultural influences on built space. At the same time, this study serves to bridge several of the papers in this special issue and elsewhere that lucidly demonstrate humans' adaptations to the Mediterranean climate in subsistence and settlement strategies (e.g. Weiberg et al., 2016; Jazwa and Jazwa, 2017; see also papers in this volume by Cheung; McNamee et al.; Dibble and Finné; Jazwa and Collins-Elliott).

## 2. Mediterranean climates in brief

The world's Mediterranean (alternatively "Mediterraneoid," or "Mediterranean type") regions are dispersed among six continents. They are largely confined to coastal settings and a narrow range of latitudes, between 30° and 45° north and south (Miller et al., 1977; Bolle, 2003; Broodbank, 2013). The specific regions include the Mediterranean Basin in Europe, Africa, and Asia, the western coast of North America from northern Baja California to southern Oregon, southwestern Australia, western South Africa, and central Chile. Characteristic of the shared climate are the annual warm, dry summers and cool, damp winters (with rare snowfall). The areas also feature significant interannual variability in temperature, precipitation, and wind at both the macro and micro scale. Despite such interregional variability, the common climate prompted comparable floral taxa among all five areas (Fig. 2). Many varieties are similar in that they are drought-tolerant but burn readily (Blondel and Aronson, 1999; Roberts et al., 2001; Blondel, 2006; Timbrook, 2007), despite the biota of these regions including distinct compositions of plant species (Roberts et al., 2001).

## 3. Architecture and environment

That environment has some influence on the form, construction, and use of household architecture is undisputed. While domestic structures are certainly multivalent and can host a diversity of activities, a fundamental function of them are as shelters. Indeed, built architecture is essential in helping to mitigate some of the more unpleasant aspects of the natural environment, while providing comfort and security to the residents (Rapoport, 1969). Thus, some qualities of every household building are necessarily adaptations to the environment in which they are situated.

This understanding has been expressed both explicitly and implicitly in archaeological and ethnographic discussions of Mediterranean architecture for some time. A recent analysis of traditional Arab architecture in the eastern Mediterranean, for instance, shows that specific building materials, the size and placement of windows and doors, deliberate casting of shade, and other features all helped to create living environments that were warmer in the winter and cooler in the summer in accordance with the rhythm of the region's seasons (Hamza and Paz, 2016). Archaeological discussions of ancient Greek domestic structures also frequently describe architectural features as environmental responses. Examples include the use of shade along the fronts of open-facing rooms and the orientation of buildings to mitigate discomfort during seasonal changes (see, for instance, Cahill, 2002). Such studies, however, rarely focus on climatic influences specifically and implicitly assign climate a role when interpreting the buildings' forms.

This association is to be expected, especially in light of the discussions by Greco-Roman authors, architects, and natural philosophers who conceived of the environment as having a fundamental and often deterministic impact on architecture and settlement explicit. Some writings of the first century BCE author, Vitruvius, is paradigmatic of this:

[Houses] are properly designed, when due regard is had to the country and climate in which they are erected. For the method of

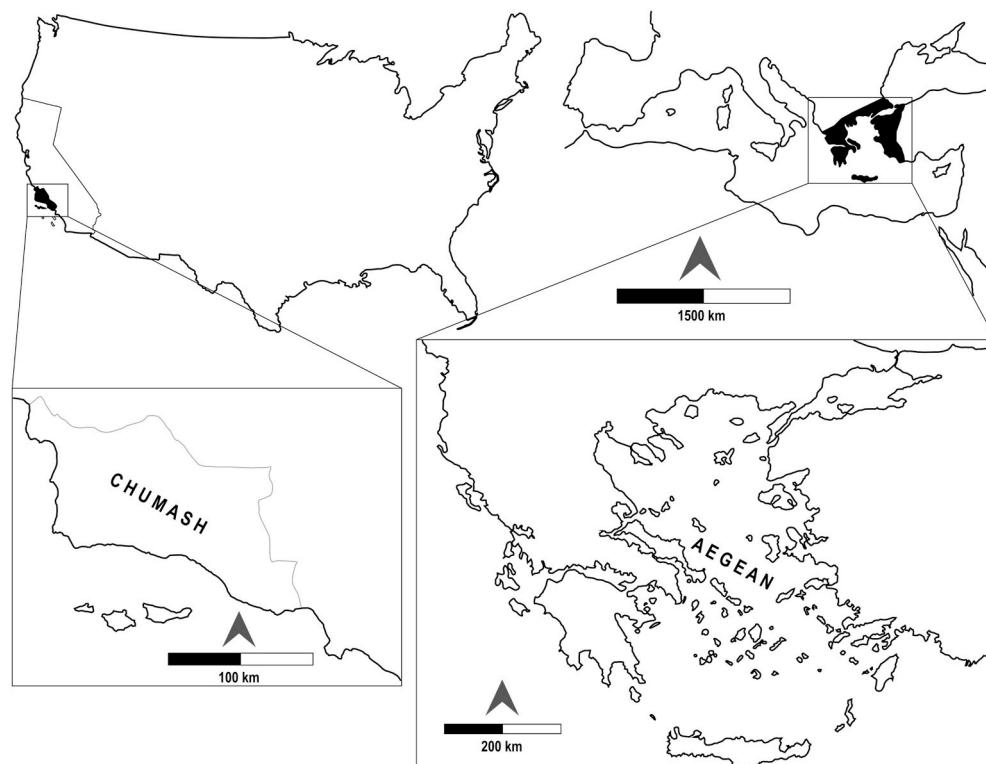
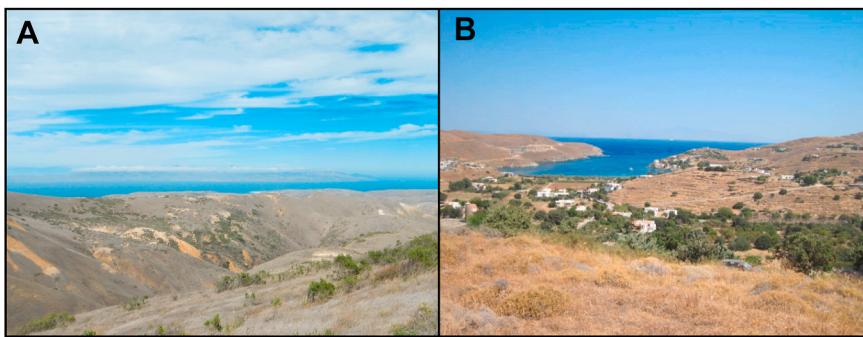


Fig. 1. The locations of our case studies. Image by K.A. Jazwa.



**Fig. 2.** The views of the environmental setting and flora at our two case studies: a) Santa Rosa Island in southern California; b) Kea island located off the coast of Attica, Greece. Images by C.S. Jazwa (a) and K.A. Jazwa (b).

building which is suited to Egypt would be very improper in Spain, and that in use in Pontus would be absurd at Rome: so in other parts of the world a style suitable to one climate, would be very unsuitable to another: for one part of the world is under the sun's course, another is distant from it, and another, between the two, is temperate. Since, therefore, from the position of the heaven in respect of the earth, from the inclination of the zodiac and from the sun's course, the earth varies in temperature in different parts, so the form of buildings must be varied according to the temperature of the place, and the various aspects of the heavens. (6.1.1–2; trans. J. Gwilt).

While Vitruvius's assertions certainly overstate the climatic influence on the final form of buildings, they do demonstrate the ancients' understanding that their own buildings were designed with some sensitivity to their local environment.

Now, scholars recognize that the design of past household architecture, in fact, reflects a complicated dialog with various inputs from culture, local history, environment, and other variables. Rapoport describes these as “modifying factors” that influence architectural design and highlights the environment as one of the more important, but not determining, modifying factors (1969). With the five Mediterranean regions sharing a relatively consistent set of climatic conditions, therefore, the residents' architecture encodes their environmental adaptations filtered through the lens of the various other “modifying factors” or cultural inputs. As such, certain underlying qualities are expected among domestic structures of many of the regions' sedentary communities.

#### 4. Case studies: geography and economy

In some respects, the geographic similarities of the two case studies are closer to each other than with the other Mediterranean regions. Not only do they share the characteristic climate, but they are positioned similarly with their mainland zones buffered by strings of nearby islands. Broodbank previously noted this, writing that, “coastal California and its offshore Channel Islands are the only parallel [to the Mediterranean Basin], in a very minor key, for the coexistence of a Mediterraneanoid climate and a maritime theater” (Table 1) (2013). Therefore, comparison of the two case studies offers the best opportunity for understanding the limits to environmental influences on the inhabitants' architecture and storage strategies.

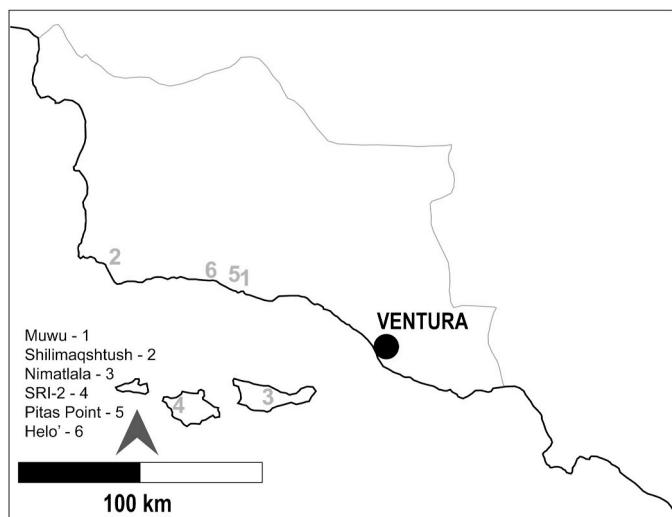
##### 4.1. Chumash and their territories

At the time of Spanish contact in 1542, the Chumash territory included parts of modern Ventura, Santa Barbara, San Luis Obispo, Los Angeles, and Kern counties in southern California (Johnson, 1988), along with the four northern Channel Islands: Anacapa, Santa Cruz, Santa Rosa, and San Miguel (Fig. 3). The islands are positioned relatively close to the mainland with the nearest insular point on Anacapa Island just 18 km away.

The earliest human occupation of the region is marked by the Arlington Springs skeleton from Santa Rosa Island, which has been dated to approximately 13,000 years ago (11,050 BCE; Johnson et al., 2002; Erlandson et al., 2011). Permanent settlements (i.e., sedentism) in the form of dense, stratified shell midden sites date to at least 8000 years ago (6050 BCE). These seem to have been focused around drainage mouths

**Table 1**  
Chronological distinction in the Aegean and California. All dates BCE except when indicated otherwise.

AEGEAN (all dates BCE)			CALIFORNIA		
Neolithic	Early	6800/6500–5800	middle Holocene	early Holocene	9750–5600 BCE
	Middle	5800–5300			
	Late	5300–4700/45,000		5600–1650 BCE	Early period
	Final	4700/4500–3300/3100			5500–600 BCE
Bronze Age	Early	3100/3000–2050/2000	late Holocene		
	Middle	2050/2000–1680/1600			
	Late (Mycenaean)	1680/1600–1065/1060			
Early Iron Age	Protogeometric	1000–900	1650 BCE–present		
	Early Geometric	900–850			
	Middle Geometric	850–760			
Iron Age	Late Geometric	760–700	Middle period		
	Archaic	700–479			
	Classical	479–323			
	Hellenistic	323–31			
				Middle-Late Transition	1150–1300 CE
				Late period	1300–1782 CE
				Historic period	1782 CE–present



**Fig. 3.** The Chumash study area with all sites mentioned in the text indicated on the map. Image by K.A. Jazwa.

where fresh water could be reliably found and marine resources exploited (Table 1) (Jazwa et al., 2016; Winterhalder et al., 2010). Ephemeral or low-density occupation at smaller sites from earlier periods are also evident, but more substantial early occupation may have been submerged by rising water levels (Erlandson et al., 2019; Jew et al., 2013).

The Chumash at the time of European contact are recognized for their relatively high sociopolitical complexity for a hunter-gatherer-fisher population (e.g., Arnold, 2001). The origins of this can be traced back several millennia. During the late Holocene (after 1650 BCE), there was a trend towards greater sedentism and increased reliance on fish and sea mammals relative to shellfish. This strategy allowed larger populations to be supported (Colten, 2001; Glassow, 1993; Jazwa

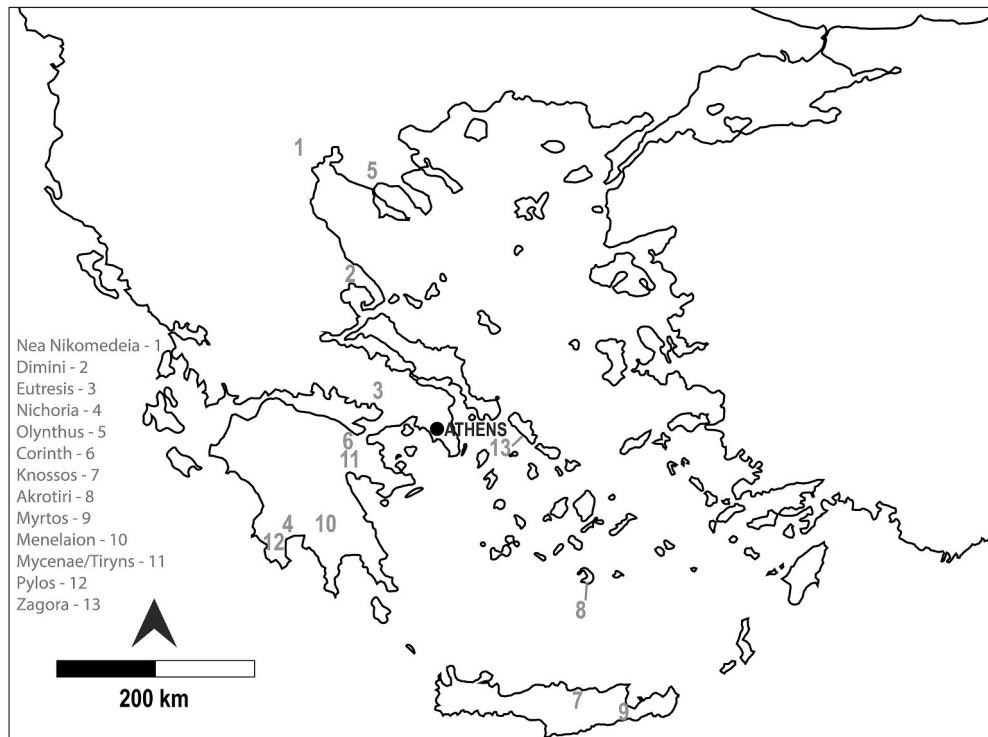
and Perry, 2013; Kennett, 2005; Raab et al., 1995) and was further helped by the introduction of the single-piece shell fishhook by 550 BCE and the *tomol* plank canoe by 450 CE (Strudwick, 1986; Rick et al., 2002; Arnold, 1995; Gamble, 2002; Fagan, 2004).

By the Late Period, Chumash settlement had condensed to a relatively small number of large coastal villages under the political and economic influence of separate chiefs (Johnson, 1988, 1993; Arnold, 1992; Kennett, 2005). This transition was assisted by the aggregation of populations around wetter, more resource-rich areas during the preceding droughts of the Medieval Climatic Anomaly (650–1300 CE; Jones et al., 1999; Jones and Schwitalla, 2008). The high return rates of the abundant marine resources also promoted the development of full-time craft specialists, dense settlement populations, and extensive exchange networks (Arnold, 1992; Kennett, 2005).

#### 4.2. The Aegean

The Aegean Sea lies in the eastern Mediterranean Basin at the divide between the Asian and European continents (Fig. 4). This sea forms the heart of the “Aegean” region that incorporates much of the Greek mainland, Ionian coast, and the interceding islands of Crete, the Cyclades, Dodecanese, and the Sporades. In modern geopolitical terms, this maps onto the nation-state of Greece and the western coast of Turkey. In our analysis, however, we focus primarily on settlements that are now within the national boundaries of Greece.

The earliest occupation of the Aegean has been the subject of much discussion and debate. Recent field work at Stelida on Naxos indicates a possible hominin presence in the region by 200 kya (Carter et al., 2019). At that time, Naxos was not an island, but was connected to the mainland due to lower sea-levels. On Crete, some lithic tools dating to more than 100 kya have been interpreted as evidence for an early seafaring population (Strasser et al., 2010, 2011; Touloukis and Karkanas, 2012; Runnels, 2014). The earliest secure dating for *H. sapiens* who engaged in seafaring and populated the Aegean islands, however, is 40–30 kya (Carter et al., 2019). Population levels were likely low for much of the region's prehistory and perhaps even uninhabited for stretches.



**Fig. 4.** The Aegean study area with all sites mentioned in the text indicated on the map. Image by K.A. Jazwa.

Following the adoption of agriculture in the 7th millennium BCE, a growth in population ensued and sedentary communities increased in frequency (Renfrew, 1972; Runnels, 1995; Andreou et al., 1996; Kotaksis, 2003; Weiberg et al., 2016).

These early settlements offer sporadic evidence for some craft specialization, like pottery production, and later communal defensive architecture (Andreou et al., 1996; Perlès, 2004; Mee, 2007; Souvatzi, 2008). Increased sociopolitical complexity in much of the region continued during the Bronze Age, with the development of full-time craft specialists and monumental architecture in some locales (Renfrew, 1972; Rutter, 1993; Broodbank, 2013). The acquisition of agricultural surplus, craft specialization, and inter-regional contact also led to incipient states including the Minoan polities in Crete during the Middle and Late Bronze Ages and the Mycenaean palatial administrations in southern and central mainland Greece during the Late Bronze Age (Renfrew, 1972; Watrous, 1994; Shelmerdine, 1997; Rehak and Younger, 1998; Broodbank, 2013).

Marking the collapse of the regional administrations and state-level organization in Greece was a period of crisis in the eastern Mediterranean at the end of the Late Bronze Age (Dickinson, 2006; Cline, 2014). The ensuing Geometric period featured low-level chiefs and/or Big Men who came to power in the small communities (Donlan, 1985; Morris, 1991; Whitley, 1991; Lemos, 2002; Coldstream, 2003; Dickinson, 2006). For many during this time, the household, *oikos*, seems to have been one of the more important organizational structures (Whitley, 1991; Coldstream, 2003; Dickinson, 2006).

City-states, *poleis* (sing. *Polis*), then emerged at the end of the Early Iron Age and during the Archaic Period. The *polis* incorporated formalized administrative structures, political and religious offices, and often monumental architecture (Ehrenberg, 1937; Morris, 1987, 1991; Sakellariou, 1989; Coldstream, 2003; Morgan, 2003; Hall, 2009; see also papers in Hansen, 1997; Mitchell and Rhodes, 1997). The specific political systems at these *poleis*, however, varied considerably. Whereas, for instance, Sparta remained a diarchy and oligarchy for much of the Archaic-Classical period, Athens witnessed oligarchies, democracy, and tyrannies within just a 200-year period. Overall, these two *poleis* were among the most well-known and influential in the Aegean until most of mainland Greece became controlled by the Macedonian king, Philip II (e.g. Walbank, 1993; Worthington, 2008).

Primary political organization around the *polis* was somewhat curtailed following this (fourth c. BCE) and the subsequent Roman conquests (second c. BCE) (e.g., Austin, 1981; Alcock, 1996; Börn and Luraghi, 2018). Between these two events, large kingdoms incorporated much of the Greek world and beyond. These regional and trans-regional states came to dominate political and economic structures of the area. Despite this, the *polis* was still a relevant organizing structure while both *polis* and *oikos* remained important loci for identity.

No matter the specific political and social structures in place at any community, agriculture remained the most common mode of subsistence in the Aegean from the Neolithic onwards. Some groups certainly pursued pastoralism with transhumant, semi-nomadic, or fully nomadic lifestyles, and it is possible that there were also hunter-gatherers living in mountainous or upland regions, especially during the Neolithic. However, the domestic structures and archaeological materials associated with these groups are difficult to identify in the archaeological record. Therefore, this study focuses primarily on the region's sedentary agricultural population.

## 5. Results

### 5.1. House structures

#### 5.1.1. Chumash house structures

Ethnographic accounts provide the best evidence for Chumash domestic structures (Bolton, 1927; Hudson and Blackburn, 1983; Chartkoff and Chartkoff, 1984; Cardenas, 2005; Gamble, 2008; Sutton, 2014).

Chumash houses typically included a frame of wood, branches, and occasionally whale bone to create a hemispherical shape (Bolton, 1927, 1930; Salls et al., 1993; Gamble, 2008). The exteriors of the structures were then covered with thatch and/or woven branches with a hole left in the roof to allow smoke to exit from the interior hearth; a low door, covered with hides, provided entrance to the structure (Fig. 5) (Kroeber, 1925; Bolton, 1927; Salls et al., 1993; Gamble, 2008). The rounded shape of the houses helped to reduce the effects of strong winds during the winter and spring seasons while providing a cooling effect to the interior of the buildings (Hamza and Paz, 2016). Occasionally, the buildings featured additional apertures or windows and, in the interior, raised platforms provided a place for sleeping. Mats and/or other loose frames were sometimes also used to help divide the interior spaces (Kroeber, 1925; Landberg, 1965; Salls et al., 1993; Gamble, 2008).

Because the materials used to construct these buildings were organic, Chumash houses decomposed easily and are difficult to identify archaeologically (Salls et al., 1993; Gamble, 2008). Typically, their physical signatures are shallow impressions in the earth with packed floor surfaces (Rogers, 1929; Woodward, 1933; Gamble, 1991, 1995; 2008; Salls et al., 1993; Rick, 2004; King, 2011). Surfaces and depressions such as these have been excavated and documented at several sites, mostly at the locations of historically-named villages including Muwu (CA-VEN-11; Woodward, 1933; Gamble, 2008), Shilimaqshtush (CA-SBA-205; Gamble, 1991, 2008), Nimatlala (CA-SCRI-324, -384; Sutton, 2014), Nimkilkil (CA-SRI-2. [N.B. CA-SRI-2 has previously been identified as Niaqla, but the size of the site indicates that it is more likely to be the much larger village of Nimkilkil; John Johnson, pers. comm.]; Orr, 1968; Rick, 2007), Pitas Point (CA-VEN-27; King, 1978; Gamble, 1983, 2008), and Helo' (CA-SBA-46; Gamble, 1990, 1991; 1995). The El Montón Site (CA-SCRI-333) on Santa Cruz Island provides the earliest clear evidence for house depressions in our study region which date to the beginning of the late Holocene (Jazwa et al., 2013; Gamble, 2017). Similar domestic structures, however, were almost certainly built earlier. This is suggested by the discovery of house depressions from the early Holocene (9750–5600 BCE) at Eel Point on San Clemente Island in the adjacent Tongva territory to the south (Raab et al., 2009).

At Chumash sites, house depressions are rarely found alone. Instead, they are typically grouped together in limited areas of settlements, forming relatively dense habitation areas. Hearths, pits, shell midden deposits, and postholes also frequently accompany the depressions within the housing areas and/or in haloes surrounding the depression. Reversals in the radiocarbon record of cultural strata among house depressions indicate that new houses were likely dug into the existing occupation or dietary refuse deposits (Jazwa et al., 2013).



Fig. 5. A partially constructed structure at Rancho Sierra/Satwiwa, Santa Monica Mountains National Recreation Area that represents a Chumash house. Photograph by K.A. Jazwa.

### 5.1.2. Aegean house structures

In the Aegean, there is considerably greater variability in the form and appearance of domestic structures. Unlike the Chumash houses, the most common design is for rectilinear-shaped buildings; but, rounded or apsidal buildings are not uncommon in periods of decline and/or lower sociopolitical complexity, such as the Middle Bronze Age and the Protogeometric (Fagerström, 1988; Mazarakis Ainian, 1997; Lemos, 2002; Wiersma, 2014; Jazwa, 2016, 2019). Most commonly, domestic structures possess at least one large, main room alongside ancillary storage and other activity areas. Westgate observed a general positive correlation between the degree of segmented domestic space within each structure and sociopolitical complexity (Westgate, 2015). Only after the Early Iron Age is there somewhat greater homogeneity in the form of domestic structures; these are almost always rectilinear buildings that feature formalized courtyards (or other open space incorporated within the walls of the buildings) and private rooms in deeper and less accessible areas of the house (Hoepfner and Schwandner, 1986; Nevett, 1999, 2010). Even so, the internal arrangements of structures display considerable diversity.

Most domestic structures in the Aegean were constructed using a standard set of building materials: stone, mud brick, and wood. In many periods and places, the architecture was characterized by stone foundations with mud brick superstructures (e.g. Nevett, 1999; Darcque, 2005; Souvatzi, 2008; Wiersma, 2014; Jazwa, 2016). Exceptions include structures made of wattle-and-daub, timber, and all stone. Difficulties in the preservation of many of these building types – specifically those that lack much stone – certainly affect our ability to reconstruct the relative frequency of each building type. This may be especially impactful for our understanding of the domestic architecture of lower status, enslaved, and/or poorer groups of people who were more likely to have used those building materials.

## 5.2. Storage

### 5.2.1. Chumash Storage infrastructure

In historic Chumash settlements, the storage of surplus food by individual households has been observed both ethnographically and archaeologically (Hudson and Blackburn, 1983; Gamble, 1991, 2008). Typically, storage facilities included baskets (woven, hide, or stone) that were sometimes lined with asphaltum for waterproofing and/or mugwort to repel pests. In form and function, the variety of baskets were numerous. Hudson and Blackburn (1983) identified several categories, including storage bags, wooden jars, Piñon storage baskets, storage granaries, and drying granaries. Many of these vessels were used to dry and store acorns, a common, high-starch food source (Craig, 1967; Hudson and Blackburn, 1983; Gamble, 2008; King, 2011; Sutton, 2014), and stored inside individual houses. On occasion, some baskets were left outside on elevated poles to function as “granaries.” These baskets are referred to as *xeim*, *ax’takui*, and/or *ak’takoi* (Heizer, 1952; Craig, 1967; Hudson and Blackburn, 1983). Well-preserved examples of Chumash baskets that date to the Late Period have been found at Cache Cave, an interior site in what is today Wind Wolves Preserve in the eastern extent of Chumash territory (Fig. 6) (Robinson, 2017). Other preserved examples are now stored in U.S. museum collections throughout California and at national repositories.

In most cases, woven and hide baskets decompose and do not remain intact for archaeologists to excavate. However, the baked clay bases that sometimes served as the foundations for these baskets have been recovered along with pieces of asphaltum that preserve impressions of weaving (Gamble, 1991, 2008). While the quantity of these allude to the prevalence of storage baskets in the region, their distribution in individual structures points to the acquisition and storage of surplus at the household scale. A household management of the outdoor basket granaries also seems likely. Although these were not formally incorporated using walled architecture, they were often brought inside specific domestic structures during inclement weather (Hudson and Blackburn,



Fig. 6. A Chumash Storage basket from Cache Cave, Wind Wolves Preserve. Photograph courtesy of Devlin Gandy and David Robinson. Originally published in Bryne et al. (2016).

1983; King, 2011).

In addition to the evidence for storage baskets, storage pits with fired clay, stone-lined, or asphaltum walls have also been identified, but with much less frequency. At Shilimaqshtush (CA-SBA-205), for instance, several asphaltum-lined and unlined pits were excavated (Lathrap and Hoover, 1975; Ciolek-Torrelo, 1998; Cardenas, 2005; Gamble, 1991, 2008). In Area 8 of the site, large depressions in the most recent floor level were identified as potential storage pits (Lathrap and Hoover, 1975), along with the nine fired clay and asphaltum pits found in the house floor of Feature 11 (Lathrap and Hoover, 1975). The asphaltum lining indicates their use for storing organic items because of the added protection against water and foraging animals that the asphaltum provides. The fragments of asphaltum with basketry impressions found in a pit in House C at Muwu (CA-VEN-11) also point to the use of baskets inside some of the pits (Gamble, 1991). Just outside the study area at the Nursery Site on San Clemente Island (CA-SCLI-1215), “many” storage pits were also revealed surrounding House Pit 1 that were determined to have been dug contemporaneously with the house itself, including one that still contained the remains of a basket (Salls et al., 1993). The contents of most pits have not been determined with certainty. However, flotation of the soil that filled some of the pits at Helo’ (CA-SBA-46) was performed, yielding direct evidence for food storage. The archaeobotanical remains included seeds and acorns from Manzanita, oaks, Wild Cherry or Islay, and nutshell fragments (Gamble, 1991, 2008).

Finally, an ethnographic account by Martinez from 1792 describes a small, individual structure at some Chumash settlements that was devoted to storage foodstuffs for the winter (Simpson, 1939). It seems to have functioned like a permanent granary of sorts, unlike the suspended baskets that certainly held less food items and were movable. Such a building may not have been the norm, but a luxury for the chiefs or elites (King, 2011).

At the time of historic contact, a process of redistribution and storage at the settlement or regional scale was also documented in some areas. Surplus food and other items were collected from individuals and households by the chiefs at times of feasts or festivals. These chiefs then stored and redistributed food to the entertainers and others involved in the feasting activities (Landberg, 1965; King, 1969; Gamble, 2008). Although large-scale storage infrastructure that provides supporting evidence for this practice is lacking in the archaeological record, many first-hand accounts, like those from Crespi’s expedition, document the gifting of beads and food from the chiefs on behalf of the community (Bolton, 1927; Brown, 2001; Gamble, 2008). A similar scene is attested during the Portolá expedition with chiefs possessing significant pools of stored foods that were deployed for feasts and other welcoming ceremonies (Chapman, 1922; Brown, 2001; Gamble, 2008).

Gamble (1991, 2008) suggests that it was, in part, the Chumash’s ability to store and later use such surplus and the high marine productivity of the adjacent coastline that allowed them to be one of the few hunter-gatherer societies to live in densely clustered settlements.

Indeed, most households were able to store enough surplus to sustain themselves in conjunction with abundant marine resources in typical years and support the demands of larger sociopolitical structures. Additional surplus staple items could also be traded to regions with comparatively fewer resources. Whereas abundant terrestrial resources were accessible at coastal mainland Chumash settlements, the variety and quantity on the islands was more limited. The latter, however, did have high-starch species like blue dicks (*Dichelostemma* spp.) – often in high densities (Timbrook, 2007; Perry and Hoppa, 2012; Gill, 2013, 2014) – but other foods such as acorns, seeds, and roots may have been used and traded from the mainland as well. Recent archaeological work has also indicated that groundstone tools were used more frequently on the islands than was previously thought, particularly during the late Holocene (e.g., Conlee, 2000; Delaney-Rivera, 2001; Jazwa and Rosencrance, 2019). These tools would have been necessary for processing foods like acorns and other seeds.

### 5.2.2. Aegean storage infrastructure

In mainland Greece, permanent storage infrastructure proliferates shortly after the adoption of agriculture. At the Early Neolithic settlement of Nea Nikomedia, for instance, seeds for the subsequent year's planting were stored in ceramic vessels, while other food was found to have been stored in pits (Youni, 1996; Souvatzi, 2008). By the Late Neolithic, ceramic storage vessels, sometimes fixed or partially buried in the floor, became more common, though pits were occasionally still used at some sites, like Dimini (Tsountas, 1908; Hourmouziadis, 1979; Halstead, 1995; Perlès, 2004; Souvatzi, 2008). It is likely that the total storage was further augmented with woven, hide, and/or other containers that do not survive in the archaeological record. Alluding to a substantial weaving and basketry traditions in the prehistoric Aegean are the impressions of woven mats that are sometimes preserved on the bases of ceramic vessels, like on several Early Helladic (Early Bronze Age) II pots from Tsoungiza (Pullen, 2011).

From the Neolithic period onward, evidence for storage at the household scale is ubiquitous. This is true for periods of comparatively advanced state-level regional organizations, like the Mycenaean period, as well as of lower complexity, such as the Protogeometric period (1000–900 BCE). Eutresis, a site with habitation during the former period, for instance, has storage pits, bins, and/or pithoi associated with almost all its households, like House A (Goldman, 1931; Darcque, 2005) (Fig. 7a). Occupied during the latter period, Nichoria's Units IV-1 and IV-5 contained stone-lined pits and stone platforms with the remains of ceramic pithoi (storage vessels) found in the latter (Fig. 7b) (McDonald,

1983; Mazarakis Ainain, 1992, 1997).

Storage vessels and buried storage infrastructure remained common in households during the historic period of Greece as well. For instance, the settlement on the North Hill of Olynthus, which was established largely anew in the fifth c. BCE and densely occupied until 348 BCE when Philip II of Macedon destroyed the *polis*, contains many excavated houses arranged in orthogonal city blocks. In most of these structures, storage vessels were found in courtyards, long covered *pastas*, and other rooms (Robinson and Graham, 1938; Nevett, 1999; Cahill, 2002). It was also not uncommon in the Aegean for domestic structures to have had rooms dedicated entirely to storage. This is seen at House A4 at Olynthus (Cahill, 2002; Westgate, 2015) and Building 2 and Punic Amphora Building at Corinth (Williams, 1979, 1981; Westgate, 2015). Altogether, the type of storage infrastructure remained consistent over time in the Aegean with the household remaining the primary organizing unit for acquiring and maintaining the storage of surplus.

There were also periods when surplus was extracted from the households under the authority of overarching administrative structures. This was the case during the period of the mature Mycenaean palatial system, when some staple food items and other resources were collected by the palaces for storage, processing, redistribution, and/or exchange (Renfrew, 1972; Halstead, 1988, 2011; Lupack, 2011; Nakassis et al., 2011; Schon, 2011). To accommodate this, substantial, centralized architecture for storage was sometimes constructed. The magazines that are attached to Minoan "palaces" of the Middle (Minoan) and Late Bronze Age in Crete are prime examples. The Neopalatial palace of Knossos features nearly an entire wing of storage magazines (Fig. 8) (Evans, 1921; Christakis, 2004, 2011). These rooms were long and narrow with raised benches on either side of the long walls that supported massive ceramic pithoi. Drains were then installed in the centers of the rooms to accommodate any spillage.

### 5.3. Exterior household spaces

#### 5.3.1. Chumash exterior space

The archaeological record of the Late Period suggests that the Chumash extensively used outside spaces to conduct daily domestic activities. Although the household did not formally delineate such activity areas with any permanent walls, the association between house structures and outside activity areas is implied by the distribution of exterior features and the arrangement of the houses themselves. At Pitas Point (CA-VEN-27), for instance, five linearly arranged house depressions were excavated with several midden pits and ovens

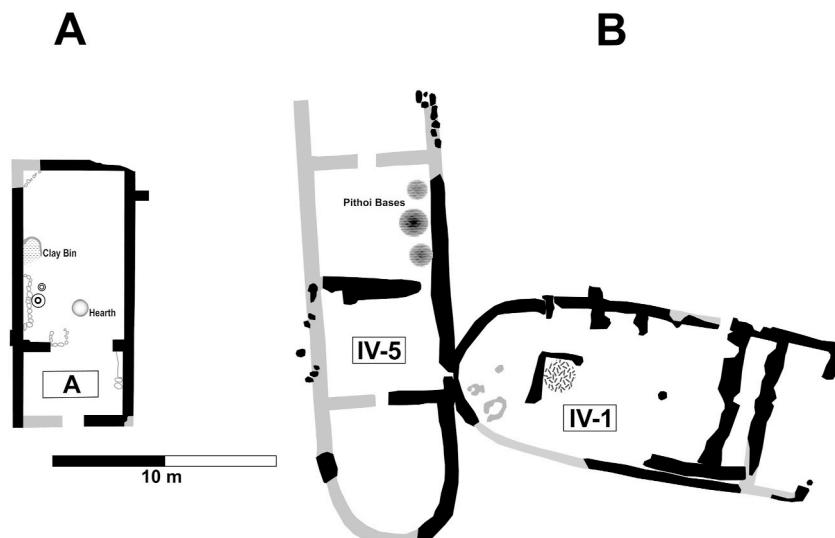
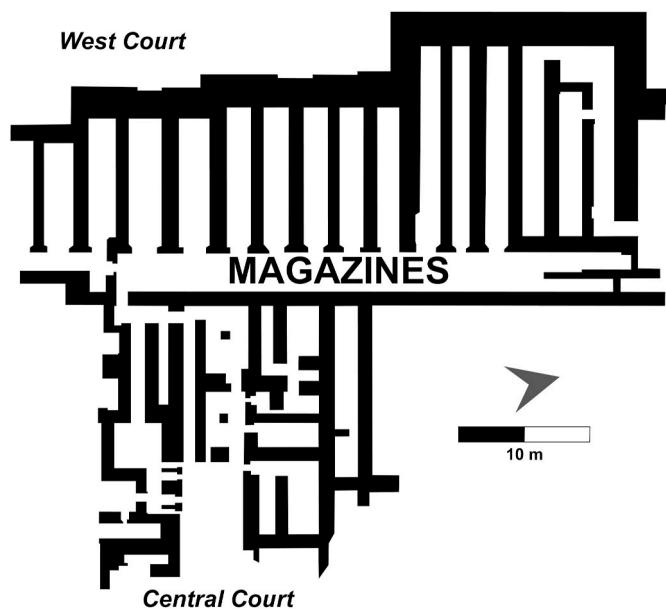


Fig. 7. Locations of storage at Eutresis (a) and Nichoria (b). Image by K.A. Jazwa, modified from (a) Goldman (1931) and (b) McDonald (1983).



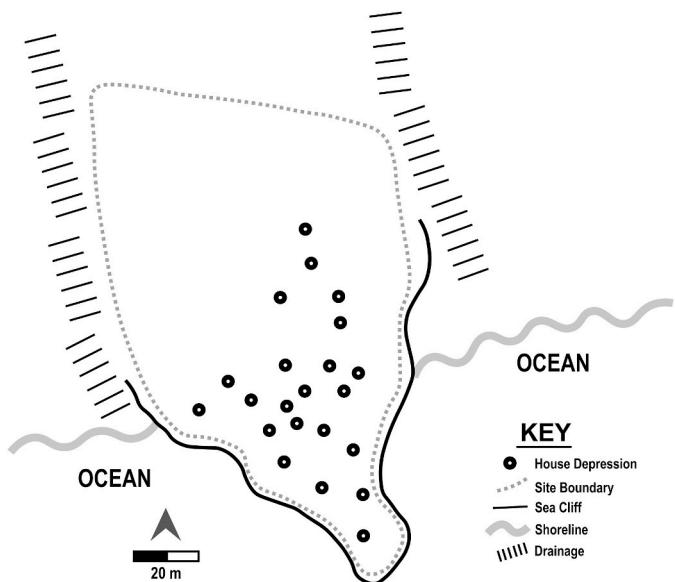
**Fig. 8.** The magazines at the palace of Knossos (Crete). These long, narrow rooms stored significant quantities of grain, wine, oil, and other food items. Image by K.A. Jazwa, modified from [Evans \(1921\)](#).

surrounding each ([Gamble, 1991, 1995; 2008](#)) (Fig. 9). These areas were used for a variety of tasks, including food preparation, basket making, pestle production, cooking, and storage ([Gamble, 1983, 2008](#)). Their haloed arrangement also suggests notional affiliations with specific households. Such a pattern is evident, for example, at Shilimaqshtush (CA-SBA-205). Similar to the houses at Pitas Point, Feature 26 includes a series of pits surrounding a house floor ([Lathrap and Hoover, 1975](#)). Reports from Martinez's mission in 1792, moreover, directly attest to exterior storage around individual houses by the coastal Chumash ([Simpson, 1939; Gamble, 2008](#)).

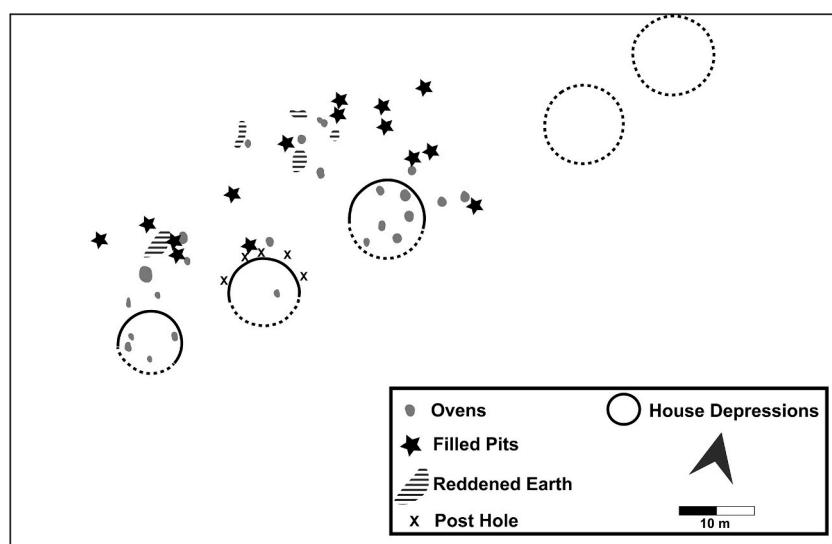
The arrangement of houses in defined rows and with relatively consistent-sized spaces left between structures at certain settlements also indicates a shared cultural understanding that some exterior space must be reserved for each household ([Gamble, 2008](#)). Although the boundaries separating individual domestic structures were not clearly defined with walls and were likely somewhat permeable, this settlement

organization ensured that houses did not abut each other and left each with enough space for its outdoor activities. The village site of Nawani on Santa Rosa Island (CA-SRI-97) is an illustrative example with its houses aligned evenly in a triangular pattern with clear space between them (Fig. 10).

Ethnographic accounts also describe infrastructure that was associated with individual households and left outside for much of the year. With the outdoor acorn drying baskets and granaries being brought inside domestic structures during rainy weather ([Hudson and Blackburn, 1983; Gamble, 2008](#)), the relationship between outdoor activities and individual households is made most apparent. At certain times of the year, windbreaks were also constructed for individual houses ([Hudson and Blackburn, 1983; Gamble, 2008](#)). These created visual and functional boundaries between structures, effectively delineating and associating outside space with specific buildings. Finally, the movement of dirt and previously deposited midden material to create berms at houses' edges during the construction process also distinguished the



**Fig. 10.** A map of the distribution of house depressions at CA-SRI-97. Field drawing by H. Radde (November 9, 2019) digitized by K.A. Jazwa.



**Fig. 9.** A Plan of Pitas point with the linear organization of house depressions and surrounding ovens, pits, and other features. Image by K.A. Jazwa, modified from [Gamble \(2008\)](#).

structures.

Even the shapes of the Chumash structures were well-adapted to the Mediterranean climate. Not only did the rounded roofs help to regulate the hot summer temperatures, but on occasion they could be used as functional spaces (Gamble, 2008). Historical accounts indicate that the rounded roofs were sometimes treated as a storage and drying area for fish (Gamble, 2008). The roofs were especially suitable for this because they were focal points for the hot and dry summer sun. Moreover, they did not occupy otherwise free exterior space in what could be densely inhabited domestic areas of settlements.

### 5.3.2. Aegean

During the entirety of the study period in the Aegean, the association of exterior space with individual households was typical. Only in the earlier periods of the Neolithic were exterior spaces extensively shared among houses. Such areas served, among other purposes, as communal food preparation areas (Theocharis, 1980; Halstead, 1992b, 1995; Perlès, 2004; Souvatzi, 2008). This practice greatly diminished by the onset of the Bronze Age (Halstead, 1995). The Late Neolithic settlement of Dimini, for instance, demonstrates rigidly defined settlement organization that formally associated outdoor areas with specific households (Fig. 11) (Hourmouziadis, 1979; Halstead, 1992b; Souvatzi, 2008).

Individual households were arranged radially in areas defined by concentric perimeter walls girding the mound along with dividing walls. Analysis of the site's architecture and finds has led to the clear identification of at least four distinct domestic units with each including at least one larger room, several smaller rooms/structures, and irregular open spaces between these structures (Hourmouziadis, 1979; Andreou et al., 1996; Perlès, 2004; Souvatzi, 2008). Although the distribution of finds and storage associated with food preparation and storage are more commonly found indoors than outdoors, these activities are not excluded from exterior areas which remained features of the household units (Andreou et al., 1996).

At many settlements in the Aegean (e.g., Minoan Crete and the Bronze Age Cyclades), the flat roofs of rectilinear structures were also used as functional outdoor spaces. This is suggested by architectural fragments indicating a well-reinforced flat roof and the layouts of some settlements, like Myrtos, which have some rooms that were entirely inaccessible except from the roof (Shaw, 1971; Warren, 1972; McEnroe, 2010). Wall paintings also show individuals standing on and using the exterior surfaces of the roofs, such as in the Flotilla fresco and the Minoan Town fresco from the Akrotiri (Doumas, 1992). Thus, even when household structures abutted other buildings, exterior activity areas could still be accommodated.

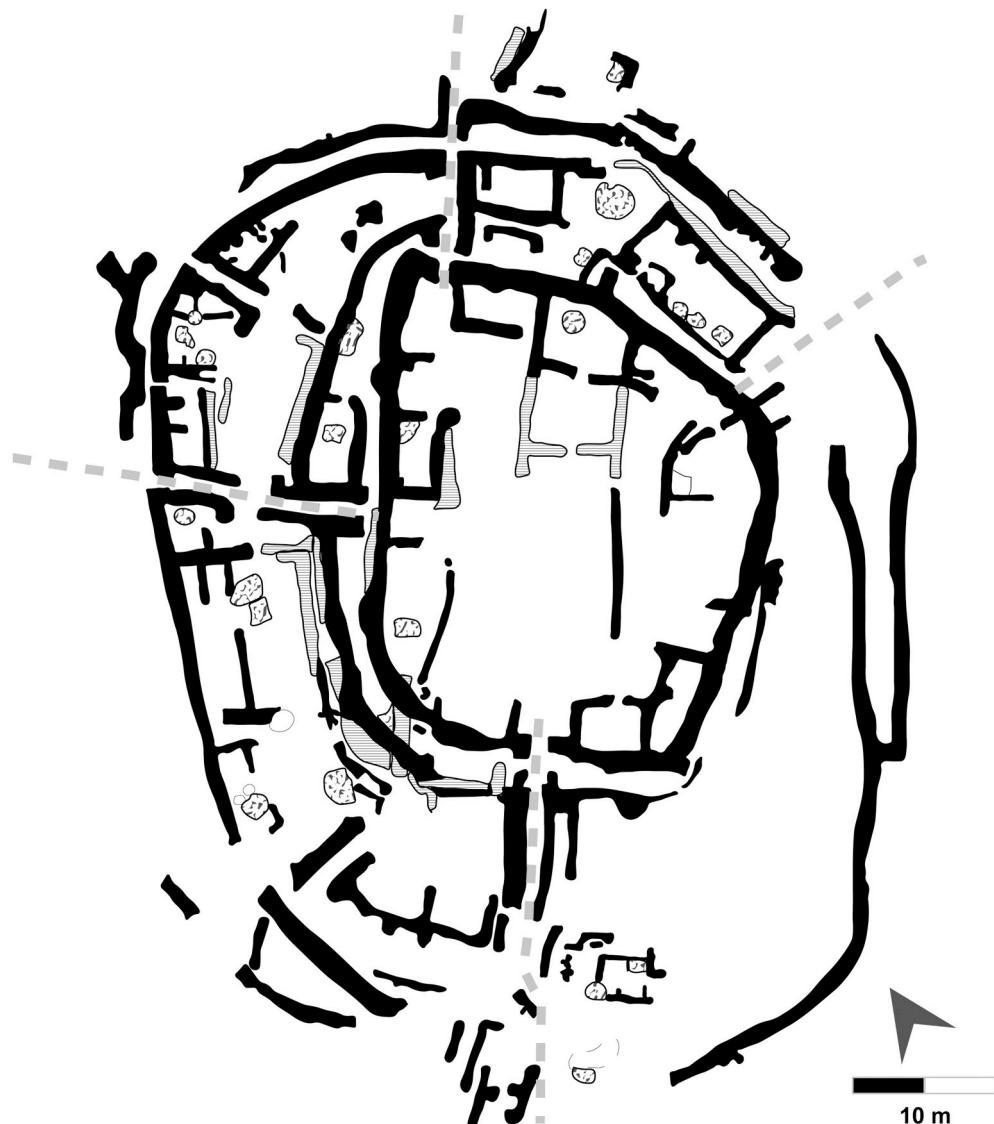


Fig. 11. The site of Dimini with households separated in the plan. Image by K.A. Jazwa, modified from Hourmouziadis (1979).

In periods with low population aggregation, when the direct evidence for the use of outdoor activity areas is less extensive, the importance of exterior areas is implied by alterations to the buildings' design. This is the case during the Protogeometric period, for instance, when most structures were relatively simple in plan, like Nichoria Units IV-1 and IV-5 illustrated above (Fig. 7b) (McDonald, 1983; Mazarakis Ainian, 1992). On average, Protogeometric architecture is much more open than its predecessor, with easier and more visible connections between indoor and outdoor areas; for instance, the period's doorways increase in average length by 31% (1.07–1.40 m) and built thresholds which formally mark the distinctions between spaces decrease by nearly 30% (Jazwa, 2019). The more minimal segmentation of the architecture and increase in the average size of buildings' main rooms to more than double their earlier surface areas also suggest less specialization of the rooms and greater flexibility in the types of activities that could occur anywhere which point to a more fluid definition of the household area (Jazwa, 2019).

The most common approach for incorporating exterior space in the Aegean, however, was with courtyards. Courtyards were essential components of the Minoan palaces and, during the Late Bronze Age, became more frequent in Mycenaean elite architecture. Prominent buildings with courtyards include the Menelaion in Laconia, Megarons A and B in Dimini, and the palaces at Mycenae, Tiryns, and Pylos (Darcque, 2005). In this context, such areas were essential gathering spaces that allowed groups to witness and participate in rituals, feasts, and

other important inclusionary/exclusionary activities at the local and regional scale (e.g. Bendall, 2004). Towards the end of the Early Iron Age, courtyards started to become integral features of vernacular domestic structures. At the 8th century BCE settlement of Zagora on Andros, for instance, courtyards accompanied most domestic units in the second phase of the settlement (Cambitoglou, 1972; Cambitoglou et al., 1988, 1992; Westgate, 2015). And, by the fifth c. BCE, courtyards and related outdoor spaces became fully entrenched as near-ubiquitous elements of Greek domestic architecture in the Aegean (Hoepfner and Schwandner, 1986; Nevett, 1999). Often, courtyards were surrounded by peristyles that helped shade the interior rooms while allowing the movement of air into those structures and regulating the temperature and comfort of those in the interior spaces.

Olynthus's houses, like the House of the Many Colors, are somewhat paradigmatic of this architectural type in the historic period (Fig. 12). Nearly every building at that site possesses at least one courtyard (Robinson and Graham, 1938; Nevett, 1999; Cahill, 2002). According to the distribution of the finds, these spaces and the shaded *pastas* that often abutted the courtyards were used for various household activities and crafts like weaving (Nevett, 1999). Although other "types" of houses were built in Classical-Hellenistic Greece, they almost always had some type of open-air space that was enclosed with the external walls of the building (Hoepfner and Schwandner, 1986; Nevett, 1999).

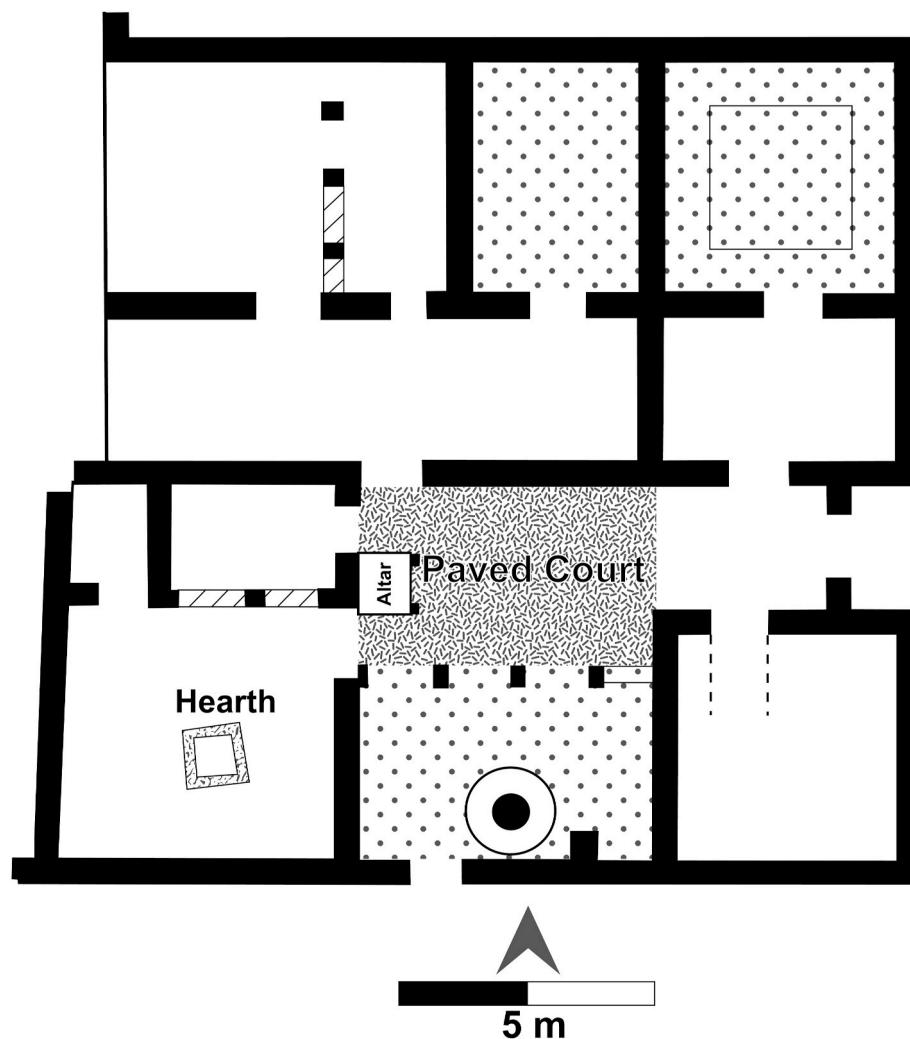


Fig. 12. The House of Many Colors from Olynthus. Its paved courtyard is at the center of the building. Image by K.A. Jazwa, modified from Cahill (2002).

## 6. Discussion

These descriptions highlight two domestic adaptations to the Mediterranean environment that are held common in the Aegean and pre-contact southern California: the primary organization of surplus at the household level and the direct incorporation of outdoor spaces to the household. Although such adaptations are not unique to this climate zone and are not manifested identically in different regions, societies, and local communities, we argue that they are emergent properties of the Mediterranean climate.

In typical years, the Mediterranean climate was favorable for survival in both geographic regions, providing abundant and diverse flora and fauna that could sustain entire households through the collective efforts of its members. This does not mean that life in a Mediterranean environment was not without risk. Characteristics of this region's climate are an annual period of lower productivity (i.e., winter) and interannual fluctuations in precipitation (Horden and Purcell, 2000). The periodic droughts varied in frequency, duration, and intensity, making the regions' pre-modern inhabitants unclear of the duration of each episode (e.g., Forbes, 1992; Nicault et al., 2008; Jones et al., 1999). Therefore, several strategies were adopted to mitigate these inherent risks and ensure survival during the winter.

In areas where the inhabitants relied primarily on agriculture like the Mediterranean Basin, the storage of staple items during productive periods was pursued as a primary safeguard, while diversification in crops and landholdings was also pursued (Renfrew, 1972; Horden and Purcell, 2000; Broodbank, 2013). Storage also occurred among coastal hunter-gatherers in California (Hudson and Blackburn, 1983; Gamble, 1991, 2008), but interannual and longer-term variability was also addressed through changes in patterns of mobility (e.g., Kennett, 2005; Jazwa et al., 2016). Such movement was helped by the considerable environmental fragmentation at the local scale including microclimates, which allowed for easy access to different resource patches (Horden and Purcell, 2000).

No matter the subsistence regime – hunter-gatherer-fisher or agricultural – the acquisition and storage of high shelf-life foods at the household scale was shared by inhabitants of both regions. In most periods, these were integral for ensuring the long-term survival of the sedentary populations. With surplus acquisition and storage typically managed by households, therefore, the associated infrastructure, when preserved, is almost always evident in and around the permanent domestic structures in the form of baskets, ceramic vessels, and lined pits to store food items for periods longer than a single year.

In the Aegean, the focus of the storage efforts was often on foods comprising the so-called "Mediterranean Triad:" cereals (barley, wheat, etc.), grapes (in the form of wine), and olives (as olive oil) (Renfrew, 1972), while diet was supplemented with meat, seafood, and other plants including vegetables and pulses (Renfrew, 1972; Hansen, 1988; Halstead, 1992a, 1994). During most periods, the wine and olive oil were typically stored in ceramic vessels, and grain was kept in granaries, protected pits, and other infrastructure. The amount of surplus cereals stored in household granaries even became a marker of wealth and status in Archaic Athens with the highest class comprising the *pentakosmedimnoi* – those who possessed 500 *medimnoi* (sing. *medimnos*) of cereals. 500 *medimnoi* was more than enough to sustain an individual household for a year (*Ath.* 7.3). Emphasizing the association of stored grain and wealth in earlier periods, the 9th c. BCE "Rich Athenian Lady" burial in Athens possessed a ceramic chest bearing five ceramic granaries (Smithson, 1968, 1969; Morris and Papadopoulos, 2004; Liston and Papadopoulos, 2004). With status tied, truly or symbolically, to a household's surplus food, it emphasizes that the household was the scale at which surplus was acquired and managed.

The subsistence patterns of the island and coastal Chumash during the Late Period were more marine-focused than in the Aegean. Despite this, households still aimed to gather a surplus of stable food items, like acorns, seeds, dried berries, and dried fish, which were kept in the pits

and baskets in and around individual houses (Hudson and Blackburn, 1983; Gamble, 2008). There, too, the available surplus may have become loosely associated with status, as chiefs often sponsored feasts in which great quantities of food were distributed to the community and guests (Chapman, 1922; Brown, 2001; Gamble, 2008).

In both regions, therefore, the ability to access surplus food by individual households has contributed to narratives associated with the rise in sociopolitical complexity. A portion of the excess was available to be directed towards supporting a subset of the population that was not engaged entirely in agriculture or hunting-gathering-fishing. Such individuals could specialize in crafts, inter-regional exchange, cult/religion, and/or leadership (e.g., Arnold, 1992; Hayden, 1995; Gamble, 2008). The differential availability of surplus also led to social inequality and stratification within communities (O'Shea, 1981; Halstead et al. 1982; Halstead, 1988, 1989; 1994; Gamble, 2002, 2008). Broodbank (2013) comments on the ostensibly similar developments in both regions, noting environmental and geographic qualities as possible contributing agents. In regard to the Chumash, he writes that "it is intriguing that here, from about 800 CE and especially after 1150 CE dense ideologically charged canoe-borne networks between chiefly communities arose that look similar to formations in parts of the Mediterranean four millennia earlier."

More than this, the material imprints and scale of storage are also quite similar in both regions and over time. Baskets, lined pits, and bags were all shown to be used by both the Chumash and inhabitants of the Aegean in and around their households. Only in the Aegean, however, were ceramic storage vessels adopted and widely used. There, pottery technology was transferred or developed shortly after the adoption of agriculture, and eventually full-time specialists arose who were dedicated to the craft. This did not occur in southern California despite the advances in sociopolitical complexity and craft specialization. Because storage was maintained by the household and the climate is similar in both regions, the popularity of pottery in the Aegean as a mechanism for storage must be attributed to unique historical circumstances or specific cultural/social factors rather than the simple need to acquire and store surplus.

Outdoor activity areas, like storage infrastructure, were also fundamental components of the domestic arrangements in both regions. The precise forms of these attached exterior spaces, however, demonstrate even greater variability than the expressions of household storage. In some instances, attached exterior spaces are merely implied by the placement of storage and other activity features in rings around individual structures; in other cases, the space was architecturally incorporated as walled courtyards. No matter the form, the use of these outdoor spaces was certainly a response to the Mediterranean climate which, even with the variable annual precipitation, featured an abundance of non-rainy and pleasant days (Renfrew, 1972; Horden and Purcell, 2000; Bolle, 2003; Lionello et al., 2012; Broodbank, 2013). For much of the year, these spaces provided functional extensions of the household area and helped to enforce a clearer sense of household ownership.

We turn to this shared feature, in particular, to illustrate the central point of our paper. By recognizing the use of outdoor space as an adaptation to the Mediterranean climate, the cultural and social influences that resulted in its various expressions can be highlighted. In the Aegean, for example, its evolution may, in part, encode some changes in the attitude towards gender relations within the household. The status of women and its relationship to architecture is a topic that has become especially prominent Classics and Greek Archaeology. Several texts, such as *Lysias 1*, attest to rigid gender distinctions within the household that could be formalized by the arrangement of built space. An element of control over women has been identified, for instance, in the courtyard arrangements that are typical of these periods. The courtyards in most Greek homes were functional spaces that allowed household activities to be completed outdoors, while protecting and securing them within the formal boundaries of the household (e.g.

(Nevett, 1999). The strict incorporation of this outdoor space with high walls and restricted access from the outside simultaneously hid the household's women and the culturally female activities, like weaving, from the public gaze (Nevett, 1999, 2005; Cahill, 2002). Nevett (2005) highlights this social quality of the architectural form after identifying divergences from that "single entrance, courtyard house" type in Attica. At Thorikos and Ano Voula, for instance, the courtyards and domestic interior were accessible by more than one entrance to the surrounding community, suggesting that there was, in fact, less control over the domestic space in these communities that had smaller populations and, thus, greater familiarity among the communities' residents.

When viewed from this perspective, the arrangement of attached exterior space in the Protogeometric also suggests fewer overt and architectural mechanisms for control over women compared to later periods. Courtyards were not at all common, while the houses of the period demonstrate greater permeability and connectivity to exterior spaces (Jazwa, 2019). As such, it would have been much more difficult to separate women from the community and public when they were pursuing activities outdoor. This suggests slightly different cultural conventions regarding gender compared to the later periods. A recent study offers some support to this, which suggests that women held a much more prominent role in craft production during the Early Iron Age (a period that includes the Protogeometric period) (Murray et al., 2020). The authors argue that women were essential in the production of pottery for the household. With the firing of pottery necessarily occurring outdoors, there were more opportunities for interaction between women and the public. It is precisely when courtyards and a greater segmentation of space become more common in the Aegean region that pottery production was largely (or entirely) usurped by men. While the architectural changes are certainly not owed to the changes in the identity of craft specialists specifically, the differences in the expression of the use of outdoor space may be reflections of the broader changes in gender relations.

### 6.1. Patterns in other mediterranean regions

With the Mediterranean climate present elsewhere in the world, we expect similar environmental responses to be evident in the regions' architecture and storage artifacts. We, therefore, offer a brief summary of the domestic adaptations to the Mediterranean climate in southern coast of Western Australia, coastal Chile, and the west coast of South Africa, to further highlight the role of local culture in variability in these adaptations.

In southern Australia, the archaeological evidence for domestic structures is minimal. Ethnographic accounts indicate that most structures throughout Australia were rounded and made of loose building materials, while in colder areas in the south and southwest, homes were sometimes weatherproofed and insulated using bark and other materials (Memmott, 2007). During periods of pleasant weather, it was also noted that many lived outside with minimal architecture except for occasional shade structures and windbreaks (Memmott, 2007). Alluding to existence of notional "households," Hallam (1975) states that the placement of fires and hearths helped to foster a sense of place and home for individual families.

Open-air settlements which have been identified by their associated shell middens have also been recognized in western coastal South Africa (Deacon et al., 1978; Schweitzer, 1979; Deacon, 1984; Henshilwood, 1996; Mitchell and Whitelaw, 2005). More common, however, was the use throughout the Holocene of the abundant caves and rockshelters. Indeed, there is little evidence overall for constructed domestic architecture, even after the adoption of sheepherding in some areas and sedentism in the later first millennium BCE (Mitchell and Whitelaw, 2005). While Avery (1974, 1976) notes that stone 'hut circles' at Pearly Beach and potential kraals have been reported in the Seekoei River valley (Sampson, 1984; Deacon, 1984), these appear to be exceptions, rather than the norm. It is, however, possible that domestic structures

were constructed of ephemeral materials like in Australia.

Finally, in southern central Chile, sites from pre-ceramic periods have been identified along the coast, near lakes and river/stream mouths. The settlements are relatively shallow and low density with shell middens comprising much of the archaeology (Berdichewski, 1964; Falabella et al., 2016; Falabella and Sanhueza, 2019). Remains of domestic architecture are also minimal, but rectilinear stone structures and constructions of ephemeral material have been identified sites associated with the Aconagua culture, including Huechún 3 and Ruinas de Chada (Falabella et al., 2016). The latter also preserved a central open area (Planella and Stehberg, 1997), presumably for household activities. Other sites, such as Cerro Grande de La Compañía, also have evidence for domestic activities outside the built structures as suggested by the distribution of ceramics and other materials (Planella et al., 2004). Thus, it seems quite possible that there were attached exterior spaces associated with some households. Further study, however, is necessary to confirm this assertion.

In Australia, high mobility and use of organic materials for construction are reflected in minimal archaeological evidence for storage. In an 1841–1843 ethnographic account of an aboriginal settlement near modern Bunbury in Western Australia, Austin writes that "each family in the tribe had its own territorial division, its own *ka-la* or 'fire-place' ... each person knew what there actually was on his own possessions, what birds' nests, etc. When anything showed itself in abundance, the neighbors, etc., would be asked to come over and partake" (Roth, 1902). Although there is no mention of storage infrastructure, this account implies that sharing was a preferred strategy to long-term storage.

Storage infrastructure in South Africa was identified, but not definitively associated with specific households. At the Late Stone Age site of Montagu Cave, for instance, a grindstone found near a pit had plant corms of the *Homeria* sp. and/or *Moraea* sp. variety (Deacon, 1984). Pits like these that were found at other sites in South Africa were most likely used for storage as well (Deacon, 1976, 1979, 1984). Physical storage containers included ostrich eggshells for storing and transporting water that have been found in many Late Stone Age deposits (Deacon, 1984). Moreover, tortoise shells were used for storing plant materials, eating, and drinking (Schweitzer, 1979; Deacon, 1984).

Especially after 1000 CE, the evidence for storage in central Chile is most substantial. This period was associated with greater sedentism and an increased reliance on cultivated resources (Bonzani, 2014; Campbell and Pfeiffer, 2017; Dillehay et al., 2007; Silva, 2014; Falabella et al., 2016; Falabella and Sanhueza, 2019). Maize especially was targeted for cultivation, in part because it offered long-term storage potential. An abundance of storage ceramics alludes to the development of craft specialization which was made possible by and helped with the acquisition and storage of staple food items in quantities beyond subsistence.

In short, arriving at satisfying conclusions from a comparison among the five regions is hindered by the comparative lack of sedentary communities and permanent architecture. Despite this, some of the features discussed in this paper, particularly related to storage, are evident in the archaeological record. Further examination of the stone-built architecture of Mediterranean Chile after 1000 CE, especially, offers the most promise for qualifying the assertions and underscoring the cultural variability associated with shared architectural traits.

## 7. Conclusions

This paper demonstrates similar human responses to the Mediterranean climate in the structuring of exterior space and the storage of surplus staple food items in the Aegean and pre-contact southern California regions. With the Mediterranean climate providing a relative abundance of terrestrial foods during certain times of the year (summer) and lean times in another part (winter), occupants of the Aegean and the Chumash acquired quantities of resources beyond their base subsistence requirements and stored the excess to manage seasonal fluctuations and interannual variability. Despite the inherent risk associated with the

environment, the reliably warm and sunny summers were also conducive to using exterior spaces as productive activity areas because of minimal rain and frequent windy days.

These observable similarities indicate that climate certainly had a role in the domestic strategies of these regions. While these underlying features are not unique to Mediterranean environments, they were shown to be common among the inhabitants. The precise expressions of these environmental adaptations demonstrably varied among cultures and regions and over time. A recognition of the environmental inputs provides a framework within which to compare the local historical trajectories of the different regions and allows for a more fundamental understanding of each of the individual cultural systems.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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