

RESOURCE STRESS AND SUBSISTENCE PRACTICE
IN EARLY PREHISTORIC CYPRUS

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Classical Art and Archaeology)
in The University of Michigan
2010

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For my parents, Roger and Kathy Button, my first and best teachers.

Acknowledgments

First, I wish to thank the members of my committee: Sharon Herbert, Henry Wright, Nicola Terrenato, and Lauren Talalay. The professors and curators in IPCAA, the Kelsey Museum, and the Museum of Anthropology at Michigan also furnished welcome advice and assistance. On Cyprus I had the good luck to work with Sturt Manning, Carole McCartney, Steven Falconer, Kevin Fisher, Paul Croft, and Eilis Monahan. I am also grateful to Ian Todd and Allison South for their hospitality in Kalavassos, and for sharing their intimate knowledge of the Vasilikos Valley. Stuart Swiny and Alan Simmons patiently answered questions, while Bernard Knapp and Matthew Spigelman were kind enough to share drafts of their work. Most foreign scholars who work on Cyprus for any length of time come to know the Cyprus American Archaeological Research Institute (CAARI) in Nicosia as a second home. The Director, Tom Davis, Diana Constantinides, the Librarian, and Vathoulla Moustoukki, the Executive Assistant, helped with a hundred things.

My fellow graduate students in IPCAA, anthropological archaeology, and Near Eastern Studies have been my most encouraging colleagues and most honest critics: Lindsey Ambridge, Lisa Cakmak, Cat Crawford, Henry Colburn, Ryan Hughes, Tom Landvatter, Amanda Logan, Charlotte Maxwell-Jones, Adrian Ossi, Colin Quinn, Dan

Shoup, and Adela Sobotkova. Emily Holt provided encouragement and support from the first day of this project to the last.

Financial support for research and writing was provided by the Rackham School of Graduate Studies at the University of Michigan, the Interdepartmental Program in Classical Art and Archaeology, the International Institute, and the John Griffiths Pedley Travel Fund.

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CHAPTER 1
RESOURCE STRESS AND SUBSISTENCE PRACTICE
IN EARLY PREHISTORIC CYPRUS

All agricultural life, the best part of Mediterranean life, is commanded by the need for haste. Over all looms fear of the winter: it is vital to fill cellars and granaries.

-Fernand Braudel (1972(1949), 256))

"What you've rediscovered, in your own very humble way," he went on, "is that we must have a spatially bounded universe with a series of populations in it, and that we must draw samples from those populations in such a way as to recover data on the nature and sources of variation. And that's no more, and no less, than what I like to call The Basic Paradigm of Good Archaeology."

-the Great Synthesizer (Flannery 1976, 8).

This study deals with subsistence practice on the island of Cyprus, in the Eastern Mediterranean Sea, between the 9th and 3rd millennia BCE: specifically, the role of strategies or mechanisms for dealing with the effects of periodic resource shortages. It seeks to characterize variability in subsistence practice among village sites over the course of this 6,000 year period, investigate how these practices relate to the nature of risk experienced by village societies, and to suggest how subsistence practices relate to social change. Briefly, a variety of strategies for managing subsistence risk were introduced to Cyprus in the Aceramic Neolithic along with

agricultural domesticates, and continued to develop through the Ceramic Neolithic and the Chalcolithic periods (see Table 1, below). These strategies were nested, in that they responded to stress at different scales. They had to be adapted to local conditions, which varied considerably, and they were not uniformly successful. At several points in time, the repertoire of strategies changed markedly, whether in response to the mechanisms' failure or due to social changes arising out of the unintended consequences of the buffering mechanisms themselves. Several buffering mechanisms, especially the use of stored surplus but also careful management of hunted animals, were manipulated at times of critical change by aggrandizing individuals or sub-groups, contributing to social inequality—which, however, was relatively short-lived before the Early Bronze Age, a period not covered in this study.

The focus here on documenting and attempting to explain *variability* in early agriculture within a particular region (cf. Iriarte 2009) may require some explanation. Nearly every archaeology student has at some time seen a slide lecture illustrated with scenes of people plowing with draft animals, sowing seed by hand, taking water from a canal with a swipe or *shadouf*, reaping with sickles, threshing, grinding grain by hand or in animal-powered mills, or herding sheep and goats. Such images are valuable, insofar as they represent ways of doing things which in the circum-Mediterranean are increasingly rare. They also give students, most of whom have no first-hand experience with traditional agricultural methods, ideas about what past peoples' daily activities and concerns were like, and some of the kinds of behavior that shaped the archaeological record. But these images also have the potential to be

problematic, in tacitly perpetuating the idea that

Period	Absolute Dates
Akrotiri Phase	ca. 10,500 BCE
Aceramic Neolithic/Cypro-PPNA	ca. 9000-8200 BCE
Aceramic Neolithic/Cypro-PPNB	ca. 8200-5200 BCE
Late Aceramic Neolithic/Khirokitean	ca. 7000-5200 BCE
Late Neolithic/Ceramic Neolithic	ca. 5200-4000 BCE
Chalcolithic	ca. 4000-2500 BCE

Table 1. Chronology of the Early Prehistoric of Cyprus

villages and traditional agricultural practices are not simply conservative but a fossil record of a monolithic agrarian past (Jarman et al. 1982). Just as people in Southwest Asia followed a variety of pathways from reliance on wild plant resources to agriculture (Willcox 2005), early agriculturalists followed divergent paths to the well-tested “Mediterranean” agricultural economies represented by these familiar scenes.

Documenting and explaining variation in past people's subsistence practices, at every level from individual households to entire regions, is essential for understanding not only the development of food production, but social changes such as household autonomy, the emergence of persistent material inequalities, and increases in social

complexity (Halstead and O'Shea 1989; Feinman 1995; Bender 1995; Bar-Yosef and Meadow 1995; Twiss 2008; Iriarte 2009). In the circum-Mediterranean, ethnographic and ethnohistorical data reveal a wide range of viable agricultural strategies on the part of individual farmers and households, generally operating within parameters established by tradition, but changing seasonally according to perceived risks and anticipated needs (Halstead 1987; Halstead 1989; Halstead and Jones 1989; Mee and Forbes 1987; Jones and Halstead 1995). Considerable variation in agricultural strategies also existed within and between past societies in the Mediterranean basin. The plant species cultivated, and the proportions in which they were grown, singly, as monocrops, or in the same field, as maslins; techniques for cultivation, sowing, crop rotation and fallow; animal management; the distribution of farmers' dwellings relative to their land, the sizes of human population aggregates, all were subject to variation, in response to environmental, technological, and social pressures.

Environmental factors influence both human biology, through natural selection, and humans' non-biologically based behavior, not in a mechanistic or deterministic fashion, but by providing strong pressures encouraging the formation of and adherence to patterns of behavior. At the same time, it is necessary to recognize that humans act with creativity, planning, and strategy (Bourdieu 1977(1972); Giddens 1977; Giddens 1979; Bandura 2001). Many workers in biology and ecology distinguish explanations relating to two kinds of causes, proximate and ultimate, the first the stimulus that evokes an observed response from an organism and the second an explanation of the advantages of that response for the organism in terms of survival

and reproduction, which explain why it has been selected for over time (Tinbergen 1963). The proposal of an ultimate cause in no way precludes the existence of multiple proximate causes in each of the observed cases, nor of different proximate causes in different cases. Thus, there is no contradiction between the claim that people do things as a result of individual, culturally-situated decisions, and emotive states, and the claim that these actions tend to exhibit patterning and that the cumulative results have material consequences, both intended and unintended, for individuals and societies.

Archaeological data frequently give low resolution on the decision-making processes of individual agents. More often, from patterning in the material residue of behavior, we adduce explanatory models as “a construct designed by science to account for practice” (Bourdieu 1977(1972), 27), frequently unrecognized by agents but implicit in their behavior. The goal of such modeling is not an attempt to describe enormously complicated real-world situations in perfect detail, but purposefully to reduce them to a comparatively small set of variables, in order to investigate the relationships among those variables. These relationships are often convoluted, since variables act upon one another, and non-linear, such that small changes in inputs can have vastly different changes in outcomes. Increasingly, models take into account very high levels of complexity in real world behavior, as in the study of foragers' social networks (Hamilton et al. 2007).

It is prudent to avoid making the assumption that all observed behavior is an integral part of optimally functioning cultural systems in equilibrium. Just as ecological systems are seldom in equilibrium in nature, some kinds of human

behavior, habits, and processes tend to constitute “deviation amplifying” processes or feedback loops leading to systemic change (Maruyama 1963). Nor can specific cultural behaviors always be assumed to confer upon their practitioners an indelible adaptive advantage in survival and reproduction. In other words, while culture enables humans to survive under conditions in which they would otherwise perish, and while all human behavior has consequences for subsistence, survival and reproduction, not all cultural behavior is best explained by recourse to those consequences. In addition, all action involves adaptive trade-offs: early agriculturalists, for example, may have increased their fitness at the expense of their health and longevity (Lambert 2009).

Issues of variability, agency, social structures, and human incorporation in ecological systems intersect in the study of the mitigation of subsistence risk (Winterhalder 1986; Halstead and O'Shea 1989). As Rowley-Conwy and Zvelebil put it (1989, 44), all human groups must meet feed themselves continuously with resources whose availability is unevenly distributed in time and space. Winterhalder et al. (1999) have stressed the need for explicit definitions of several concepts: risk, uncertainty, hazard, and value. They use *risk* to refer to unpredictable costs or benefits for the same behavior (Winterhalder et al. 1999, 302). Agents may have information about the relative probabilities of different outcomes: *uncertainty* refers to a lack of information about risk, which can partly be overcome by experience and exchanging information (Wobst 1974, Whallon 1989). Winterhalder et al. use *hazard* to refer to potential sources of harm (or lessened benefit), while *value* can describe either

biological fitness or economic utility, or a combination of the two (1999, 303).

In their introduction to a collection of influential studies on “bad year economics,” Paul Halstead and John O’Shea argued (1989) that it was useful to explain the benefits of different subsistence strategies not only in terms of the total calories produced, but the necessity to guard against the negative effects of environmental risk. Halstead and O’Shea proposed different kinds of behavior tending to reduce subsistence-related risks, which they termed “buffering mechanisms.” They suggested these could be placed in four categories: mobility, diversification, physical storage, and exchange. Despite the name, these buffers were not mechanistic, but were rather patterned responses developed over time within the context of their societies. In other words, they constituted forms of practice which channeled behavior but within which there was ample room for strategy (cf. Bourdieu 1977[1972]). Some buffering mechanisms, those related to foreseeable times of scarcity, tend to be well-understood by participants in a society, and are subject to active manipulation (Halstead and O’Shea 1989, 3; Hayden 1995). In the case of stress events which are unanticipated, or occur on a time frame longer than ordinary social memory, institutions may serve a buffering function of which people within the society may not be aware (Halstead and O’Shea 1989, 3). Halstead and O’Shea therefore distinguish (1989, 4) between low-level and high-level mechanisms, the first capable of coping with variation within the normal range, and the second capable of responding to infrequent, disastrous shortages regarding which there exists a high level of uncertainty.

For the purposes of analysis, Halstead and O’Shea consider other humans

outside the specific group under investigation as part of the environment, just as ecologists may consider some organisms part of the environment for analytical purposes. Relationships with groups outside the one defined for the purposes of analysis are also subject to change, potentially effecting the efficacy of strategies of mobility and exchange. What constitutes a useful group for purposes of analysis may depend on the spatial scale of known and independently measurable environmental stress. Where variation in natural environmental parameters such as rainfall is high over small areas, as is often the case in the Mediterranean (Halstead 1987; Halstead 1989; Forbes 1989; Christodolou 1959), one farmer or one village might experience stress while neighboring farmers or villages are unaffected. Where such variation is closely correlated over large areas, groups in proximity to one another may experience stress at the same time.

Hamish Forbes' work in the Methana region of southern Greece (Forbes 1989; Mee and Forbes 1997; Forbes 2007) identified complementary buffering mechanisms in traditional agriculture: fragmented land holdings by individual households, polycropping, excessive sowing and overproduction, and long-term storage of physical surplus. Forbes argued that these traditional responses to risk are structured in a hierarchical way, appropriate to stress on different temporal and spatial scales, and categorizes them as first-defense mechanisms, safety-net mechanisms, and emergency mechanisms (Forbes 1989, 90). The longer certain practices existed, the greater the extent to which they were legitimized by their longevity—and justified to curious ethnographers with the simple explanation “our grandfathers did it that way” (Forbes

1989, 87). This has led to a tendency among some archaeologists (who should know better) to assume that apparently longstanding ways of doing “traditional” agriculture must represent the way things were done in prehistory (see Halstead 1987 for dissection of this problem). Forbes additionally suggested (1989) that some of these mechanisms act to retard social change outside the realm of subsistence behavior, an observation which is particularly relevant for the case of prehistoric Cyprus. It is not suggested that the case of modern Methanites provides an especially good parallel for the archaeological data presented in the following chapters, at least not in terms of specific behavioral analogies. Rather, it is an illustration of the nested and complementary nature of buffering strategies.

Another example can be found in Richard Ford's ethnographic study of a Tewa pueblo in New Mexico, where farmers were required by religious prescriptions to produce corn of single colors (Ford 1977). This necessitated cultivating spatially discrete plots, which was inefficient in terms of time and energy, but had the effect of reducing the risk of total harvest failure. When scarcity occurred despite these precautions, community feasts had the effect of redistributing corn from well-off families to hungry ones, helping at the same time to maintain social cohesion. If food stress was too severe, the pueblo might fission, with members of junior lineages being sent to establish a new village (Ford 1977). While subject to decisions based on specific situational factors, all of these practices were part of a culturally maintained behavioral repertoire. Not all these responses were consciously aimed at reducing subsistence risk, but all had that effect under the conditions observed by Ford, even

where agents brought their own agendas to the feast. Just as in southwest Asia, evidence from across the American Southwest reveals a wide spectrum of responses to ordinary variability and extraordinary stress (see, for example, papers in Tainter and Tainter 1996).

In addition to creating strategies of mobility, diversification, storage, and exchange to deal with familiar environmental parameters, people may also act to alter those parameters to reduce risk and permit the intensification of food production. Such environmental management may include activities such as digging wells, terracing hillsides prone to erosion, clearing land, introducing new species of plants and animals, and managing familiar species in different ways. Not all such attempts at environmental alteration are successful. For example, humans have traditionally found it difficult to make rain fall reliably or ensure an abundance of game, though many groups have highly elaborate ritual strategies aimed at accomplishing just those goals (Marcus 2008, Kelly 1995). In population biology, “niche construction” is used to describe processes in which organisms make changes to their environment that increase not only their own fitness but that of conspecifics and offspring (Laland et al. 1999; Hubbell 2001). The term may be useful to describe a wide range of human behaviors. Niche creation does not fall neatly into any of Halstead and O’Shea’s categories, but is worth considering as risk-buffering behavior—particularly in cases of early agriculturalists moving into new and less familiar environments.

This emphasis on the roles in buffering against shortages played by practices and institutions should in no way be construed to mean that buffering is the only role

they play, or that the only useful way to think about food is in terms of calories. Getting enough calories and getting them consistently is only one aspect of subsistence practice. Socio-cultural anthropologists have tended to stress the symbolic aspects of food and consumption, and some archaeologists have attempted to follow suit. Yiannis Hamilakis, for example, has written off ecological archaeology as an “inadequate and misleading” endeavor, one that perpetuates a man/nature dichotomy which Hamilakis sees as uniquely “Western,” and treats consumption as purely a matter of provisioning rather than a kind of social action and signification (Hamilakis 1999, 56). This critique seems tendentious and unnecessarily dismissive of an entire branch of science. Surely ecology, in treating humans as organisms relating to the countless other organisms which together constitute an environment, destabilizes rather than promotes a human/nature dichotomy. In fact, such a dichotomy may be a useful and entirely appropriate one for many analytical ends, “Western” or otherwise (Winterhalder and Smith 2000). More importantly, to make an argument about the survival value of a behavior is not to imply anything about how it was understood by ancient people, nor to deny that it had cultural significance above and beyond filling bellies. Finally, even a cursory review of literature in human ecology would have revealed that workers in this field have long taken into account considerations beyond survival and calories, addressing questions about the social value of ecosystems and organisms, whether as food or in other capacities (Rappaport 1967; Kottak 1980; Winterhalder 2002; Kottak 2006).

By virtue of being (usually) a daily event, eating tends to be structured by

practice, invested with meaning above and beyond the satisfaction of hunger.

Whatever the diverse political, symbolic, and emotive uses and associations of food, many of which are not immediately susceptible to recovery from the archaeological record, calories and nutrients are always and everywhere indispensable, if people are not to starve. Therefore it seems reasonable to distinguish, for purposes of analysis, between subsistence practice (strategies for getting enough calories and nutrients) and food ways (what is done with available calories).

It is also reasonable to consider both subsistence practice and food ways in terms of their effects on other patterned social behavior. Preparation, presentation, and consumption of food are arenas in which an egalitarian ethos may be maintained, obligations created, incipient inequalities minimized or exacerbated, status distinctions demonstrated, group membership expanded or restricted (Gosden 1989; Kelly 1995; Hayden 1995; Arnold 1996; Cordell 1996; Hayden 2001, Perodie 2001). These activities may be invested with other forms of social meaning as well; some features of behavior, like food taboos or “reserved foods” (Halstead and O’Shea 1989, 9) act at the same time as buffering mechanisms. Changes in the social presentation of food may relate, for example, to elites’ use of feasting to create and demonstrate asymmetric power relationships at the same time such feasts continue to represent a safeguard against starvation for unlucky members of the group. In other words, there is no necessary contradiction in understanding the “function” of behavior in terms of the safeguards it provides against starvation, and understanding the same behavior in terms of social interaction, communication, and the “selfish” strategies of individuals

and factions.

Meaning attaching to the acquisition, preparation, presentation and consumption of food is often situationally dependent, based on the social roles of the participants and the history of their interaction. Here too, archaeology often provides better information about patterns of behavior than specific events. Approaching questions about the social significance of consumption practices using a material record rather than direct observation of human behavior, including discourse, requires both creativity and intellectual honesty, since it is usually easier to say with confidence what people ate than what it “meant” to different social actors. Arguments about the significance of certain kinds of foods or consumption practices, such as the existence of an ideological investment in deer hunting on Cyprus, require strong supporting evidence. However, even if we cannot recover all aspects of behavior, from a sufficiently large set of cases it is not difficult to recognize that some kinds of behavior, whatever their different cultural meanings and nuances, were apparently favored again and again by the selective pressures acting on people because of their need, like all organisms, to obtain energy from the environment.

In short, archaeologists can infer from material culture a high degree of variability in past subsistence behavior, driven by a large number of proximate causes, including food producers' individual ambitions, abilities, and strategies. These strategies, however, were continually tested within a stochastic environment, which tended over time to produce favorable outcomes and encouraged people to rely on those resources (Rindos 1984; Winterhalder and Kennett 2006) and to follow those

patterns of behavior which had in the past succeeded in providing security for an uncertain future (Halstead and O'Shea 1989; Winterhalder et al. 1999). It is useful, therefore, to conceive of cultural behavior in general and subsistence practice in particular as incorporating buffering mechanisms to address environmental variability on different temporal scales, from daily risks to risks which occur with a periodicity of many years. The former mechanisms are the most susceptible to manipulation by individuals and households, while the latter tend to be embedded in social institutions which have many other actual and ostensible functions; their role in buffering risk might be latent for long periods of time (Halstead and O'Shea 1989). These practices, traditions, and institutions are subject to change by social actors for reasons that may or may not have to do with subsistence, but such manipulation may turn out to have consequences for subsistence regardless of social perceptions. Indeed, individuals and groups often do not recognize the role of certain patterns of behavior in moderating risk.

Buffering strategies can be studied not only in terms of statics--how established mechanisms provide insulation from known environmental risks—but dynamics, how environmental or social changes overwhelm old mechanisms, render them obsolete, or require the development of new ones. A useful example of dynamic change in nested buffering strategies is the case of the Wodaabe of Niger (Legge 1989). These pastoralists possessed a flexible repertoire of traditional responses to environmental variability, particularly drought, on a variety of time scales: seasonal, annual, and interannual. These responses fit well with the categories for buffering

mechanisms proposed by Halstead and O'Shea: mobility, diversification, storage, and exchange. Moving long distances and gathering information allowed Woodabe herders to move their animals to the most productive grazing areas. Running mixed herds of cows, sheep, goats, and sometimes horses and camels provided diversification: browsers and grazers required different plant foods and did better under different conditions. Herds represented not only a continuing source of calories for humans from milk, but a reserve of meat which could be consumed or traded, effectively a mobile store, while the Woodabe's symbiotic relationship with farmers, involving exchange of labor and livestock for agricultural produce and grazing rights, provided additional alternatives. In cases of severe or protracted stress, when herds were decimated and animals had to be sold, Woodabe herders might themselves turn to agropastoralism, cultivating crops while hoping to rebuild their flocks. The system worked well until the French administration in Niger adopted policies that severely handicapped traditional methods of buffering, making the Wodaabe vulnerable to drought and other sources of risk (Legge 1989).

Cases such as that of the Woodabe suggest the whole repertoire of nested buffering mechanisms is subject to “pinch points” where the conditions under which they are developed—i.e., the normal range of variation in environmental parameters—change dramatically. This in turn has the potential to create severe disruptions and rapid social change (Halstead 1989). At such times, when the well-tested repertoire of ordinary stress responses have failed for many or most agents, innovation produces a variety of new responses, which, analogous to biological mutations, may succeed or

fail dramatically. Those strategies most successful under new conditions tend to be reproduced disproportionately.

It is often useful to model subsistence in systemic terms. It is essential first to recognize that models of systems are inherently reductive, and therein lies their value: identifying the most consistently important variables and the most important relationships among them. A systems approach allows for the identification of feedback loops, which can be either positive or negative, deviation-amplifying or homeostasis-seeking (Maruyama 1963). This provides an alternative to identifying cause and effect where “chicken and egg” situations arise. Real-world situations are also usefully modeled as non-equilibrium systems, complex and adaptive, ones in which many variables are interdependent, such that change in one variable affects many others. Such models have been used to good effect in ecology, especially landscape ecology, which deals with relationships among different sets of organisms (Turner 2005). Similar models are used in archaeology with the recognition that even where the inputs are necessarily imprecise, the models represent a useful way of investigating the nature of relationships among environmental parameters and cultural behavior (Ehrlich 1973; papers in Earle and Christenson 1980; Winterhalder and Smith 1992; Odum 1994; Wright 2008).

Within Southwest Asia, food production, the evolution of agricultural domesticates and animal species, the origins of early villages and of incipient social complexity have all been intensively investigated for many years (Pumpelly 1908; Childe 1939; Braidwood 1960; Binford 1968; Flannery 1969; Flannery 1973;

Braidwood 1973; Rindos 1984; Watson 1995; Redding 1995; Moore and Hillman 1992; Moore et al. 2000, Kujit and Goring Morris 2002; Wright 2008). These issues are now often treated as related but independent (Watson 1995). Towards the end of the Pleistocene, a time of dramatic worldwide climate change, foragers in Southwest Asia began to rely heavily on a few plant and animal species, invest heavily in storage of surplus, and limit their residential mobility (Flannery 1972). The transition from highly mobile foraging to food production was associated with a widespread reduction in the use of certain buffering mechanisms, such as long-distance mobility, and an increase in the use of others such as storage (Kujit 2009) and diversification (Munro 2004). All these responses had been in the human repertoire for a long time, and often deployed, but never, apparently with such dramatic success. Evolutionary biologists speak of a phenotypic gambit: when a trait or behavior goes from low to high representation in a short period of time, they infer that it was favored by a strong selective pressure as conferring a major advantage in survival or reproductive success. Food production apparently confers such a benefit, since the adoption of food production strategies tends, worldwide, to be followed by evidence of large increases in population (Rindos 1984).

Village societies after food production were also dynamic, however, and they should not be treated as a static or homogeneous “agricultural base” on which complexity was built. In the 8th and 7th millennia BCE, when agricultural domesticates were in widespread use throughout SW Asia, societies were heterogeneous: the sites of Jericho, Catalhoyuk, , 'Ain Ghazal and Atlit Yam represent very different

constellations of subsistence strategies, symbolic behaviors, orientation to the natural environment and to other human groups (Simmons 2007, Kujit and Goring-Morris 2002). From a point of view focused myopically on subsistence, and not dealing directly with ritual, identity, or other problems, the village societies of the Aceramic Neolithic (PPNA and PPNB) in southwest Asia exhibit a big range of site sizes, with different strategies followed at different times within environmental zones ranging from comparatively lush to challenging for early farmers. It is reasonable, therefore, to expect that the specifics of their buffering strategies will have differed considerably.

The region of Cyprus, in the eastern Mediterranean Sea, has often been considered an insular oddity, a case of “cultural retardation” (Held 1993). The island adopted ceramic technology and the use of metals long after these came into widespread use on the adjacent mainland, while retaining “archaic” behavior and material culture such as animal economies centered on deer hunting and round, monocellular houses (Swiny 1989, Croft 1993). Many workers now see these features of Cypriot material culture in terms of cultural choice and identity definition, which is entirely plausible, but they must also have had consequences for survival and reproduction; though apparently these did not impose a sufficiently drastic fitness cost to be quickly replaced by the kinds of behavior more prevalent in the Levant. Rather than dismissed as the product of a closed system playing by unusual rules, archaeological data on Cyprus are increasingly examined in the broader context of southwest Asia (Simmons 1994, Kujit 2004, Simmons 2007, Clarke 2007, papers in Peltenburg and Wasse 2004). Data from Cyprus deserve to be considered in the

construction of models for, e.g., the spread of farming technologies and populations. Rather than an insular oddity, Cyprus may be a useful “null case” for many of the social developments apparently resulting from sedentary life in villages, and specific global climatic and local environmental changes, particularly the big growth in social complexity observed in the Levant (Clarke 2007). At this point, it will be useful to introduce some background information about the physical parameters and known culture history of Cyprus before addressing how questions of risk and subsistence practice may usefully be investigated in this region.

CHAPTER 2

THE ENVIRONMENT AND CULTURE HISTORY OF CYPRUS

Cyprus is the third largest island in the Mediterranean after Sicily and Sardinia, at about 9500 km². It is located (Figure 1) along the 34th parallel, about 65 km south of the coast of Turkey, though its far NE corner is only about 40 km south of Cilicia and 80 km west of the Syrian coast, with the coast of Egypt some 400 kilometers to the south. The island possesses two mountain ranges: the Troodos massif in the center of the island, and the steep Kyrenia chain in the North and East. The Troodos range consists of the stratified Troodos Ophiolite Complex, seabed of Upper Cretaceous date uplifted as a result of subduction in the Mesozoic, ca. 70 mya (for the geological history of Cyprus see Held 1983, with bibliography; Robertson and Woodcock 1986; Coleman 1996, 362-364). Ironically, because of the nature of the uplift and subsequent erosion, the deepest stratigraphic units are exposed at the higher elevations of the Upper Troodos while younger stratigraphic units, like the pillow lavas and younger sedimentary formations, are exposed at lower elevations (though frequently overlain with alluvial deposits). Thus, the Upper Troodos are primarily igneous (gabbros and diabase) while the

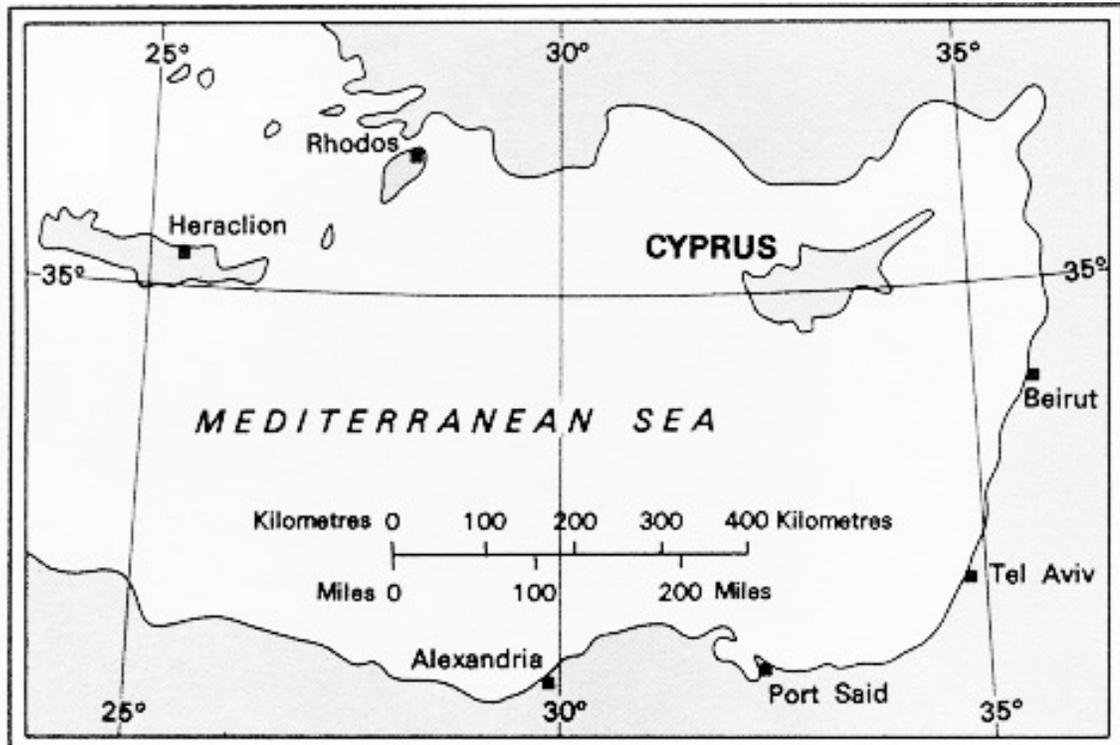


Figure 1. Location of Cyprus in the Eastern Mediterranean Sea

surface geology of the lower Troodos consists largely of Miocene sedimentary limestone. The highest point in the Troodos is Mount Olympus, at 1950m. The high peaks of the Troodos or Kyrenia ranges do not appear to have been settled in prehistory, but the foothills of both ranges were important zones for settlement and resource extraction (Catling 1962; Given and Knapp 2001; McCartney et al. 2006). Specifically, the pillow lavas contain chert, a crystalline, siliceous sedimentary rock susceptible to conchoidal fracture and therefore suitable for the manufacture of sharp chipped stone tools, and copper, which was extensively mined from later prehistory

through the modern period.

The Kyrenia mountain range is primarily sedimentary limestone, some dolomitic (Robertson and Woodcock 1986). It is not as rich in copper as the Troodos (Coleman et al. 1996, 362), and the coastal plain north of the Kyrenia range is relatively narrow (<5 km in most places), though, as has long been observed, it was extremely important for prehistoric settlement, especially in the Early Bronze Age (Catling 1962). The Mesaoria plain is located in the eastern part of the island, between the major mountain ranges. It is geologically heterogeneous and covered in alluvium. Two major rivers, the Yialias and Pedaios, describe winding courses across this plain. Cyprus has numerous other rivers, fed variously by runoff and springs. Many are seasonal, and are virtually or actually dry in the summer. Even in their dry state, they represent ecological zones that are very different from the surrounding landscape. In June through August, the Yialias river, where it runs past the early prehistoric site of *Ayia Varvara-Asprokremnos*, is scarcely more than a few centimeters deep; however, it nonetheless provides a habitat for flora and fauna—reeds and flowering plants, snakes, frogs, and birds. The Vasilikos river likewise supports riparian vegetation and animal species throughout the hot Cypriot summers.

Gasith and Resh have commented (1999) on the similarity of Mediterranean-type stream systems worldwide. This has not been explicitly addressed on Cyprus, but especially where substantial variation was present between other micro-environments (cf. Grove and Rackham 2003), the similarity of riparian zones may have important implications for the prehistoric colonization of Cyprus and the subsequent distribution

of settlement. River valleys also provided stone for ground stone tools, and other, more exotic materials. The Kouris and Diarizzos river valleys are sources of picrolite, a soft stone which was used from the Neolithic onward for ornaments and figurines of uncertain function (Xenophontos 1991).

The present-day climate of Cyprus is often said to be "typically Mediterranean." The description, while evocative, too often masks considerable spatial and temporal variation (Braudel 1972(1949), 162; Grove and Rackham 2003; Simmons 2007, 34; Knapp et al. 1994, 395; Simmons 1999, 6-8; Held 1983). Summers on Cyprus are generally hot and dry with temperatures routinely in the low to mid 40's Centigrade, while winters are cool, but rarely cold, and wet. Such differences have an effect on vegetation, but the most important factor for vegetation on Cyprus is soil moisture, and the most important contributor to soil moisture is rainfall.

The island receives from 450-600 mm/year average annual rainfall (Br. Admiralty 1923, 176-177 and Table IV), but this is unevenly distributed. Parts of the Troodos receive 800 mm annually, while the foothills of the Troodos typically receive between 500 and 800 mm and the central lowlands and south coast between 300 and 500 mm (Br. Admiralty 1923, 165; Stanley Price 1979, 9-12; Péchoux 1977, Fig. 5). Maximum rainfall at Kyrenia, Famagusta, Limassol, and Nicosia for one year varied from 168 mm (Nicosia) to 296 mm (Limassol) in January; 163 mm (Nicosia) to 310 mm (Famagusta) in December; 18 mm (Famagusta) to 102 mm (Nicosia) in June, and 1 mm to 23 mm (Limassol and Nicosia) in August (Br. Admiralty 1923: 190-191,

Table XI). The Mesaoria often receives fewer than 400 mm of rain a year, though the high water table partly alleviates the effects of lower precipitation (Held 1983, 110). Today it is some of the richest farmland on the island, though crops are commonly irrigated, which is not thought to have been the case at any point in the Early Prehistoric.

Interannual variability in rainfall for Cyprus, like geographic variability, is significant. In one year of particularly bad drought, many areas of the central lowlands and south coast received less than 150 mm (Péchoux 1977, Fig 2A). Though as Stanley Price has pointed out (1979), potential evaporation also influences soil moisture content, and we cannot assume the high potential evaporation rates recorded today (as high as 87%) characterize the prehistoric past, interannual variability in rainfall was likely the single most important variable in determining soil moisture content. Soil moisture content, in turn, is limiting factor for biomass productivity in semi-arid environments, and one of the most important sources of risk for dry farmers.

Prevailing winds are from the W/NW for the Northern Levantine coast from May through October (Br. Admiralty 1923, 196-7, Table XIII), but more easterly in November and December (198-199). Prevailing winds will have had a considerable impact on sea travel and therefore on the exchange of goods and information between people on Cyprus and those on the mainland, even in periods before the use of sail. It is interesting to note that in the 11th century Egyptian Tale of Wenamun, the eponymous protagonist takes ship for Egypt from the Phoenician city of Byblos, but is driven off course to Alasiya, almost certainly in Cyprus (Knapp 2008). As well as

affecting sea travel, prevailing winds, along with precipitation and vegetation, affect the incidence and severity of forest fires, which in recent history have caused considerable damage to crops and property (Christodolou 1959).

Modern day vegetation regimes on Cyprus are characterized by a pronounced altitudinal bioclimate gradient roughly corresponding with rainfall. This is one trend we can assume probably held true in the past, and it almost certainly influenced the location of agricultural settlements (Held 1983). Much of the low-lying coastal plain and the Mesaoria are presently either built up or under cultivation, but at lower altitudes, what forest remains is a mix of conifers and semi-deciduous oak (*Quercus coccifera*, *Q. infectoria*), with Cypress (*Cupressaceae*, *Cupressus sempervirens*), lentisk (*Pistacia*), carob, and wild olives (Held 1992). The high occurrence of endemics on islands in general is well attested, and Cyprus remains truly rich in endemic flora (Pantelas et al. 1993). Especially where soils are poorer, Maquis and garigue—ground cover composed of a number of xerophytic (drought-resistant) species of scrub oak and aromatic shrubs such as laurel and thyme—are prevalent. Much of the Troodos mountains are today covered in forest, including pines (*Pinus bruttia*, *Pinus nigra*, *Pinus Pallasiana*), the endangered Cyprus cedar (*Cedrus brevifolia*), Cyprus oak (*Quercus alnifolia*), and juniper (*Juniperus foetidissima*). It has been argued that the large-scale deforestation of the Mediterranean is a sort of literary trope introduced by early travel writers and Grand Tourists from Northern and Western Europe, who found the hills of Classical lands less lushly forested than they had imagined from reading Greek and Roman writers (Grove and Rackham 2003), but

written sources such as the geographer Eratosthenes are still often invoked to suggest Cyprus was more heavily forested in antiquity. Other workers have used different proxy data for ancient vegetation. Catling took the absence of settlements on the Mesaoria in much of prehistory to indicate that it was forested (1962, 139), while Held (1983) cites the presence of stone axes as evidence for logging. That these are the terms of the debate suggests the paucity of real paleoenvironmental data for the island.

Not only large-scale climate change but human land use and the activities of domestic animals are capable of having pronounced effects on local ecosystems. A.H. Unwin, Principal Forest Officer for the British colonial administration on Cyprus under Ronald Storrs, was moved to publish a brief but fairly polemical treatise concerning the overwhelmingly negative impact of goats on the Cypriot ecosystem and economy. “When the British Government first occupied Cyprus,” he wrote, “the Forests were in a poor condition: 237,000 sheep and 210,000 goats were in existence in the Island, causing devastating damage” (Unwin n.d., 89, capitalization in the original)¹.

Goats not only ate seedlings, decimated crops, and caused erosion, but produced rock falls that endangered foresters (Unwin n.d., 93, 115). While the environmental impact of the caprine population might not have been as severe as Unwin claims, it would be premature to rule them out entirely as a significant factor in

¹ It is interesting to compare this figure with the 100,000 sheep attested in Linear B tablets at Knossos on Crete in the Late Bronze Age (Killen 1964; Halstead 1981), a single, if preeminent, polity on an island smaller than Cyprus.

landscape change, especially where evidence for ovicaprid pastoralism coincides with independent evidence for landscape degradation. However, as Halstead has cautioned (1987), we should also bear in mind that recent historical patterns of animal husbandry and pastoralism are by no means the only possible models for prehistory. This is perhaps especially true for Cyprus, where the unusual adaptation of hunting and perhaps managing herds of fallow deer (*Dama dama*) was a long-term and widespread strategy alongside the husbandry of familiar domestic animals like sheep and goat.

The establishment of chronological and typological schemes has been a priority in Cypriot archaeology since the early twentieth century, but important chronological questions are still unresolved. Here as elsewhere in the Old World, the three age system (Stone, Bronze, Iron) provided a useful framework but has proven to require substantial revision. The “Erimi culture,” for example, originally designated as a late phase of the Neolithic, belongs in the Chalcolithic. The great Cypriot archaeologist Porphyrios Dikaios followed standard practice for his time in positing chronological phases based on type sites at Khirokitia (late Aceramic Neolithic) and Sotira (Ceramic Neolithic), but these sites are in many ways more exceptional than representative of the periods named after them, and archaeologists working in the Neolithic now more often use Cypro-PPNA and Cypro-PPNB (Pre-pottery Neolithic), Khirokitian, for the last stages of the Aceramic Neolithic, and PN (Pottery Neolithic) or Late Neolithic, a modification of the chronological system for the Neolithic on the Levantine mainland.

With the aid of artifact studies and radiocarbon dates, chronologies have been

refined sufficiently to permit discussion both of changes in subsistence practices at excavated sites and of the relationships of long-term environmental and cultural change. The following summary is necessarily a schematic one. It neglects many chronological divisions and glosses over contentious debates. But an overview of human activity on the scale of the whole island is a necessary prelude to posing specific questions about prehistoric subsistence practices.

There is currently no credible evidence for any Paleolithic human presence on Cyprus. However, there is evidence for visitation and perhaps temporary occupation by Epipaleolithic foragers at the site of Akrotiri *Aetokremnos*. Whether *Aetokremnos* reflects human predation of indigenous Late Pleistocene pygmy hippopotamus is debated (Swiny 1988; Simmons 1988; Simmons 1991; Simmons 2004; Cherry 1990; Binford 2000; Ammerman and Noller 2005; Wasse 2007). Though it initially appeared to be a singular entity, *Aetokremnos* is now able to be contextualized within a pattern of very early coastal sites (Ammerman and Noller 2005; Ammerman et al. 2008) that offer information about human responses to climate change at the end of the Pleistocene, the maritime dimension of Late Pleistocene and early Holocene foraging; human impact on Pleistocene fauna (possibly), and the conditions for the development of the first attested sedentary societies in Southwest Asia (Bar-Yosef 2001; Broodbank 2006).

One of the reasons for initial skepticism about *Aetokremnos* was the apparent absence of any subsequent occupation of the island before the well-attested Aceramic Neolithic sites at Kalavassos *Tenta* and Khirokitia *Vouni*. However, in the last thirty

years, it has become clear that there was a human presence on Cyprus that predates these two village sites and their contemporaries; additionally, Tenta has a longer occupational history than was originally suspected. It is now clear that Cyprus was home to foragers and early agriculturalists from at least the early ninth millennium, and that the earliest settlers were on the cutting edge of early Holocene plant and animal exploitation (Guilaine and Briois 2001; Colledge 2004; McCartney et al. 2007; Vigne et al. 2009).

While Khirokitia and Tenta are the best known sites belonging to the later Aceramic Neolithic. There are also several more enigmatic sites, such as Kataliondas *Kourvellos*, an enormous deposit of artifactual material including large quantities of both chipped and ground stone around a conspicuous rocky knob, possibly a landmark. Tenta and other Cypro-PPNB villages are unlike PPNB villages in the Levant in several ways: they are small; they do not adopt rectilinear architecture; their animal economies rely on ovicaprids, pigs, and deer while cattle are virtually absent and represent small fractions of the faunal assemblage where they do occur (at Shillourokambos and Ais Yiorkis in the west of the island); evidence is lacking for some kinds of symbolic behavior attested in the material record of the “core” PPNB areas of the Levant (Todd 2005, Simmons 1999).

The Cypriot archaeological record thus provides important information about the dispersal of early Neolithic technologies and people from Southwest Asia, about variability in early Neolithic subsistence strategies, which were presumably subject to strong selective pressures as the kinks in early farming were worked out under

different social and environmental conditions, and relations within and among the earliest farming communities themselves (Wilcox 2003; Colledge 2004; Redding 2005; Broodbank 2006; Bellwood 2009). While Cypro-PPNB sites are indeed within the range of variability for the PPNB overall (Finlayson 2006; Simmons 2007), variation among them in terms of their size, situation, and animal economies is significant. Below, I argue that this probably relates to localized and resilient subsistence strategies which had the effect of mitigating environmental risks for small and vulnerable human populations.

There is an apparent hiatus between the last occupations of Aceramic Neolithic sites and the Ceramic or Late Neolithic; this is based, however, on a limited set of radiocarbon determinations (Clarke 2007a). Important excavated sites include *Sotira Teppes*, *Troulli*, *Kantou Kouphovounos*, *Paralimni Nissia*, and *Ayios Epiktitos-Vrysi* (see map, Fig. 5). These village sites are economically similar to their Aceramic Neolithic predecessors. They seem to share a common house type: small, monocellular structures of similar plan. We are unsure whether each of these structures should be associated with a nuclear family (Peltenburg 1978; Stanley Price 1979b; Flannery 1973; Swiny 1989; Clarke 2007a), and there is a limited evidence as to the nature of storage at this time, whether communal, suggesting strong egalitarian principles, or private, suggesting competition among kin or corporate groups. In addition to these village sites, the Late Neolithic has a number of sites which possessed only ephemeral built structures, if any, but deep pits, sometimes connected by tunnels. Such sites include *Kalavassos Kokkinoyia*, *Dhali Agridhi*, and *Mari Paliambela*. These remain

highly enigmatic, despite recent work (Clarke 2004; Clarke 2007b).

It has been observed that sites such as Sotira and Vrysi are situated in apparently defensible locations (Steel 2004, 67). If Kelly (2000) and others (Carneiro 1994, Keeley 1996, Roksandic 2004) are correct that the level of violence among sedentary foragers and early agriculturalists was as high as in some more recent segmentary societies, it is worth considering conflict as one of the factors potentially circumscribing movement and access to environmental resources. Joanne Clarke has argued (2001) that ceramic style indicates a degree of corporate identity in opposition to other groups, though it may also reflect incorporation in exchange networks (Bolger et al. 2004). However, there are some signs of social and technological changes at this time which are important for understanding the management of subsistence risk. The adoption of ceramic technology changed the parameters for storage, while Edgar Peltenburg has argued (1993) that intra-group tensions may have been resolved by periodic fissioning. Fissioning is an important issue in the study of early villages (Bandy 2004), and is discussed at length below along with environmental evidence and implications. Despite the attention given to insularity, connectivity and identity in prehistoric Cyprus (Held 1993; Knapp 2008), few have discussed community fissioning in the context of maritime connectivity, which I will argue is important to understanding human relations with the environment, particularly in the earlier Aceramic Neolithic.

The transition from the late Neolithic to the Chalcolithic is not well understood (Bolger 1988). The Chalcolithic is distinguished by the appearance of certain ceramic

forms, and by artifacts in native copper. It is interesting to note that on an island with native copper, later to be a provider of this resource to the eastern Mediterranean, the Chalcolithic begins nearly 1500 years later than in the southern Levant. The earliest Chalcolithic sites, like Kissonerga *Mylothkia* and Kalavassos *Ayious*, consist of complexes of pits and tunnels with ephemeral superstructures, if any--much like Pottery Neolithic sites. Copper was used for utilitarian objects such as chisels and fishhooks, in contrast to its first appearance elsewhere in the form of daggers or apparent prestige objects. The Middle Chalcolithic saw the development of large sites, sometimes occurring in clusters. In addition to Dikaios' work at Erimi, the work of Edgar Peltenburg and his group at Lemba *Lakkous*, Kissonerga *Mosphilia*, and Souskiou *Laona* has been instrumental in advancing our understanding of the Chalcolithic. Chalcolithic villages were an order of magnitude larger than their Aceramic Neolithic counterparts, probably arguing a substantial increase in population; their animal economies were dependent on herding and animal husbandry, primarily of pigs and ovicaprids; but fallow deer were if anything more important (Croft 1993), a fact which requires explanation, since it stands in marked contrast to the development of mixed farming economies elsewhere in southwest Asia (Falconer 1994).

Peltenburg has argued (1998) that the Middle Chalcolithic period saw the emergence of property rights and increased social inequality. At Kissonerga *Mosphilia*, Peltenburg's team identified a "ceremonial area" with large structures whose heavily plastered walls and floors represent a substantial investment in labor,

separated from the rest of the settlement by walls and ditches. One of these structures was the Pithos House. This structure contained enormous jars whose collective capacity has been estimated at 4000 liters (Peltenburg et al. 1998). Also from the Ceremonial Area were recovered a ceramic house model and apparently ritual artifacts (Peltenburg 1989; Bolger 1991d; Peltenburg et al. 1998). Differential access within communities to natural resources and competition among communities for certain resources were likely sources of social tension contributing to the apparent unrest in the Chalcolithic.

Towards the end of the Middle Chalcolithic, some settlements were apparently abandoned, while at others there is evidence for destruction (as of the Pithos House). Cypriot archaeology has often looked to migrations, invasions, and cultural “influence” from the rest of Southwest Asia to explain changes in material culture and social organization (Knapp 2008, 1). Indeed, the historical record suggests both that large-scale population movements do periodically take place, and that they are capable of producing cultural change in the regions concerned, though this seldom amounts to a straightforward replacement of people or material culture. Late Chalcolithic material culture has been argued to have many affinities with mainland Anatolia. However, it is difficult to explore this problem fully with the northern part of the island not under the control of the Republic of Cyprus.

In short, Cyprus constitutes a useful unit for regional study. Though much work remains to be done, especially in the north of the island (Todd 2004), it has been well surveyed by the standards of the eastern Mediterranean. The Cyprus Survey

assembled gazetteers of known sites (Catling 1962), and encouraged a number of extensive surveys and several small-scale intensive ones (see lists in Todd 2004; Sevketoglu 2000). More recent synthetic treatments (Stanley Price 1972; Held 1993; Clarke 2007a; Knapp 2008) are also of great value. There is a good ceramic record for those periods in which ceramics were used –again, not without problems, but more than adequate to permit the identification of regional traditions and of phases within ceramic periods. Importantly for the purposes of this study, the Early Prehistoric also exhibits considerable variability, with villages of different locations, sizes, and compositions, as well as sites which have not been characterized as villages, either because small and apparently ephemeral, or missing categories of material evidence usually taken to belong in “villages,” such as architecture, or evidence for certain activities, such as food preparation. It will be evident that I accept “villages” as a useful analytical category, following from the general observation that small-scale low-mobility or sedentary societies tend to have things in common: not the same things in all cases, but features tending to co-occur.

Within the region of Cyprus it is necessary to establish on what scales variation in subsistence practice and risk-buffering mechanisms or strategies can be identified. Halstead and O'Shea rightly stress the need to define carefully both the nature and the scale of the since risk and risk-buffering are, in their words, “nested and all-pervasive” (1989, 7). The nature and scale of the problem with which the present study is concerned can be defined in five major questions, as follows. First, what was the degree of variability in subsistence practice among those village sites for which

adequate data exist in the Aceramic Neolithic, the Ceramic Neolithic, and the Chalcolithic of Cyprus? Second, what were the most important sources of resource stress, and how were these distributed in space and time? Third, what risk-buffering mechanisms can be identified, and what is their distribution in space and time? Fourth, do differences among villages' strategies exhibit patterning? What explains these differences? And fifth, what are the implications for the spread of was the relationship of subsistence practice and food ways to other aspects of society at different points within the Early Prehistoric of Cyprus?

In order to address these five major questions in a way that is robust and intellectually responsible, it is necessary to select an appropriate methodology for examining subsistence practice, resource stress, and social change in the region and period under examination. Throughout the course of this study, it will be essential to distinguish carefully between evidence for the nature and probable periodicity of resource stresses, and evidence for subsistence practice. Evidence for resource stress independent of people's response to it can be difficult to come by. Indeed, the better these mechanisms or strategies are at dealing with the effects of periodic resource shortages, the more pronounced this disparity is likely to be. This can quickly become a circular argument if certain archaeologically attested behavior is assumed to have provided insulation against resource shortages, shortages inferred in turn only from the presence of the behavior.

Before discussing specific lines of evidence which can be brought to bear on these questions, it is necessary to explain in what way ethnographic and

ethnohistorical evidence can be used in studying the past. Above, I have criticized their unthinking use in painting a picture of an unchanging agricultural past. They may be very helpful, however, provided information derived from them is used for an appropriate purpose, to suggest a range of behaviors which might have been available to prehistoric people—but which cannot be *assumed* to have existed in the absence of archaeological evidence. Unfortunately, ethnographic data rejected by some archaeologists on the grounds that they represent the imposition of an arbitrary analogy on the past, or treats modern groups as “fossils” without history. In fact, ethnography simply provides examples of ways in which humans deal with different kinds of conditions. Clearly no modern group represents a good model for every aspect of behavior in any ancient group. However, the judicious use of ethnographic data is arguably more useful than simply imagining different kinds of behavior for past people because we know that ethnographically observed strategies are minimally adaptive, i.e., that they allow people to survive under a set of observed environmental conditions. Naturally, this does not preclude the existence of other behavior in the past. However, if we review a sufficiently large sample of ethnographic cases, some kinds of patterning may become apparent, such as relationships between biomass on the one hand and population density or frequency of residential moves on the other (Kelly 1995). Such generalizations need not apply in every observed case to be of value: they enable probabilistic statements about conditions under which foragers are likely to become less mobile or store wild resources. Models built using ethnographic, ethnohistorical, and other archaeological data are always subject to evaluation against

the archaeological record. For example, models of agricultural origins, both general and specific, have drawn on ethnographic information but have continually evolved to take into account new archaeological data (Pumpelly 1908, Childe 1939, Braidwood 1958, Binford 1968, Flannery 1969, Rindos 1984, Redding 1988, Watson 1995, Kujit 2009).

To some extent, different investigative strategies may be necessary to address the questions posed above. It will be useful, then, to consider them individually before laying out the lines of evidence and analytical processes which will be used to answer them.

VARIABILITY IN SUBSISTENCE PRACTICE IN THE EARLY PREHISTORIC

Many modern studies of agricultural production have found a high degree of variability among the behavior of households as productive units (Sahlins 1972, Halstead 1979, Forbes 2007). It is often argued that because households are so often the basic unit of production for modern small-scale agricultural societies, that this was likely to have been the case in the past as well (Forbes 2007; Sahlins 1972, 41-99). Material evidence sometimes permits the identification of differences in subsistence activity within structures or complexes of structures, often, but not always, plausibly identified with the economic activity of households as economic units (Sahlins 1972; Flannery and Marcus 2005; Souvtatzi 2008). Such practice is subject to manipulation on a short-term basis as people make day-to-day decisions about what to plant, how to manage their livestock, how much seed will be required for next year's harvest and

how much surplus represents a “safe” amount. Household composition, the number of hands available for labor and the number of mouths to be fed, all change, sometimes dramatically or unexpectedly. Differences among subsistence practices at the household level require fine spatial and temporal resolution to detect; however, such fine-grained variability often remains frustratingly elusive.

Differences in subsistence within sites are also subject to identification, and the following study contains several examples where one group within a village might have followed a different set of practices than another group. However, we should be alert for behavior such as bimodal residential patterns or seasonality—movement between winter villages and summer pastures, or the use of winter houses and summer houses on the same site—which might produce different faunal and botanical assemblages that might initially appear to indicate two groups with different subsistence practices, where in effect those practices belonged to the same people.

For this study, sites are the basic unit of analysis, and most of the comparison of variation is at the inter-site level. Discussion of the subsistence practice of a site does not mean all its inhabitants were doing the same thing; rather, it is shorthand for an aggregate of all the community members' strategies. At different sites, this aggregate will naturally represent the behavior of different numbers of people over differing periods of time. Site A, for example, might represent the activity of twenty people all of whom were engaged in hunting deer, while Site B represents the activity of a hundred people, some of whom kept pigs and grew barley while others kept mixed flocks of sheep and goats.

Small sample sizes and differences in information quality make any attempt at characterizing variation in statistical terms problematic. Moreover, sources of error specific to specific categories of evidence must be taken into account. Categories of evidence for subsistence practice which will be used throughout this study include botanical assemblages, including pollen and wood charcoal; data about paleoclimate from ice cores and other sources; settlement patterns, faunal remains; architecture, stratigraphy, and material culture, primarily but not exclusively ceramics, evidence of physical storage in the form of pits or containers, objects likely to have been exchanged at a distance or used as tokens in systems of “social storage”; and human remains, insofar as they provide evidence for pathologies and nutrition. It is obviously impractical to discuss all of the problems which arise with these categories of evidence, well-documented in specialist literature, but at the same time it is essential to discuss how they can be combined to characterize subsistence practice.

With botanical remains recovered from flotation, not only the number of samples but the number of species recovered is often roughly proportional to the amount of flotation done; though some soils preserve botanical better than others. Identification to species not always possible, and a roster of botanicals can never be considered an exhaustive list of plant species exploited. Additionally, botanical remains recovered by flotation represent primarily those seeds and plant components which were subject to burning and deposition on site in the course of the way they were processed. Other plant foods may have been subject to different processing and deposition. For example, Boardman and Jones have shown (1990) that chaff from

free-threshing wheat tends to be underrepresented relative to the chaff of glume wheats.

Unlike other botanical remains which are primarily transported by people or by animals under their direction, pollen is usually deposited on archaeological sites primarily through wind transport from nearby pollen-producing plants; how nearby depends on the properties of pollen spores and on wind speed and direction. Pollen production is seasonal for many species, like olives, and is not constant from year to year, while wind strength and direction are also variable. These factors have the potential to introduce a certain amount of “noise” complicating the “signal” represented by the pollen. Anthracology, the study of archaeologically recovered charcoal, generally permits the identification of only arboreal species (at least in Cyprus). Wood charcoal is thought generally to derive from wood deliberately brought on site by people in the form of wooden implements, or for use in construction, or as firewood. It is therefore risky to assume *prima facie* that a given anthracological assemblage reflects accurately the relative abundance of arboreal taxa in the vicinity of the site from which it was recovered.

Botanical information is most informative when geology (since soils often determine what sort of plants are able to grow in an area), carbonized seeds and plant parts, and archaeologically recovered pollen and charcoal can be read against one another as complementary sources of information about local environment and resources. Where these agree, reconstruction of the local plant environment can be undertaken with greater confidence, and where they conflict, they can still illuminate

the processes through which people interacted with plants. Considering that the Early Prehistoric begins with the introduction of relatively recent agricultural domesticates and ends just before the introduction of the crucial olive component of the “Mediterranean triad,” such relationships are more than usually interesting.

The representation of species and elements within faunal assemblages is equally subject to being skewed by differential deposition, preservation, and recovery. For these reasons one prominent faunal analyst has cautioned that “zoological interpretation remains a frustratingly approximate art” (Croft 1998, 209). It is highly desirable, but not always possible, to assess the relative importance of different animal species in terms of their contribution to diet, but this is never as simple as simply counting bones or calculating the minimum number of individuals (MNI) of a given species represented in a faunal assemblage. Animals were killed, butchered, and consumed in different places and for different reasons, their remains were subject to deposition in different ways, and were not preserved equally. Additionally, excavation practice tends to recover remains of larger animals disproportionately to those of smaller ones. At the Chalcolithic site of Kissonerga Mosphilia in Cyprus, Paul Croft has used the results of wet sieving to estimate that 97% of the surviving bird bone was missed in excavation, as opposed to only 58% of deer bones (Croft 1998, 208).

Animal bones and particularly teeth often allow determinations as to the age and sex of animals in an archaeological context. Such age/sex profiles are a common tool for characterizing human management of both wild and domesticated animals, though all faunal analysts are aware that, especially in the Late Pleistocene and Early

Holocene in southwest Asia, the two categories are unlikely to have been cut and dried, since behavioral changes likely preceded morphological ones, and sometimes populations of feral or wild animals existed nearby sites where their cousins were kept under close human control (Redding 1995). These populations might even interbreed.

Nonetheless, where strong patterning appears in faunal assemblages, it may reflect deliberate management of animals. In a classic paper, Payne proposed (1973) that strategies which would maximize the production of meat or milk could be identified from age/sex profiles of animals. In both cases, it is advantageous for herdsman to cull a large number of young males, retaining a few for breeding purposes, while allowing a much higher percentage of females to survive, producing both milk and young animals (Payne 1973; Davis 1987, 155-7). Of course, people often depart from these idealized milk/meat curves (Halstead 1998; Russell 1999). Keswani has reviewed (1994) ethnographic evidence to suggest that traditional farmers will often slaughter domestic animals only for feasts and ritually significant occasions, not as a quotidian source of protein. She argues that animal husbandry in small scale societies is subject to “ideological and social requirements” (Keswani 1994, 261; cf. Russell 1999). Keswani shows how the failure to adhere to idealized mortality curves for the maximization of milk or meat production reflects ritual feasting, some of which is seasonal in nature. In the case of Chalcolithic Cyprus, for example, households or communities maintained flocks that included many more male goats than were necessary for the propagation of the herd (Croft 1998).

Clearly, animals in early farming societies were not simply more or less mobile

bundles of calories, but subjects of a whole set of ideological beliefs and associations (Rönen 1995, Russell 1999). We can expect individual agents to have had various motives: for example the desire to hedge against future subsistence risk, the possibility of enhancing their status through stock keeping, the importance of contributing to a feast. Forbes observed, for example, the fact that families in the Methana with lots of daughters tend to have lots of goats as well, since goat herding was a recognized way for young women to raise dowries for marriage (Forbes 2007, 240). The individual nature of such decisions does not imply the results do not exhibit patterning or that their makers, their communities, and their animals were not subject to evolutionary pressures as a result.

Davis (1989, 193) has asserted that “Neolithic people with their domestic food animals probably did not hunt to any great extent”, but throughout the Early Prehistoric period on Cyprus, fallow deer, almost certainly hunted (Croft 1993) often apparently contributed more calories than any species, sometimes more than all the sheep, goats, and pigs at a site put together. Additionally, it is by no means certain that all the members of these species were “domestic” in morphology or behavior, especially in earlier periods. Deer hunting has been described as an archaic feature of Cypriot behavior akin to Epipaleolithic practice elsewhere in the Levant (Croft 1993), which continued to be a viable strategy in Cyprus in the absence of long-term population pressure driving the intensification of ovicaprid husbandry (Wasse 2007) and a relaxation of the social demands that made cattle so important on the Anatolian mainland (Rönen 1995).

The relative importance of different sources of calories is only one part of the picture, and inadequate in itself for describing a full range of buffering mechanisms. Storage, food preparation and consumption taken together indicate what is done with those calories. Evidence for storage derives from physical features at excavated sites, especially pits but also granaries, bins, basins, and other features. Wells are not storage features *per se*, but point to the need to make a critical resource continually available. Many storage facilities constructed with perishable materials, such as baskets or boxes, are not preserved, but it is not out of the question that their presence might be inferred if some of their contents are preserved (e.g., by unintentional burning) and deposited together in discrete areas.

Evidence for food preparation and consumption provides additional information about food ways and subsistence strategies. Both plant and animal foods required processing; while ground stone and chipped stone assemblages are not the focus of this study, they may be considered in order to track large differences among sites or changes over time in some of the physical implements used for such processing. Likewise, the locations of hearths and ovens, if any, within or outside structures, deserve note. Consumptive practice is very difficult to reconstruct, but can begin to be established from the nature of surviving vessels of stone and ceramic, their spatial distribution and associated artifacts, the distribution of animal remains, particularly where these might reflect large-scale consumptive events (cf. Hayden 1995; Hayden 2009). Food, where habitually shared, may help to maintain an egalitarian ethos which will be important component of buffering strategies; or

conversely may suggest the attempts of aggrandizers (Clarke and Blake 1994) to control subsistence resources and distribute them in such a way as to gain specific benefit for themselves and their close kin (Perodie 2001). Such information is also important in discovering how people protected themselves from periodic shortages.

SOURCES OF RESOURCE STRESS, THEIR DISTRIBUTION IN SPACE AND TIME

Evidence for the nature of resource stress always derives in part from the properties of the resources being consumed: specifically, how abundant and predictable they are likely to have been in their distribution in time and space (Whallon 1989; Winterhalder et al. 1999). This is naturally informed by uniformitarian or, perhaps better, “similiformitarian” assumptions about the past. As Halstead and O’Shea posited (1989, 6), “the *relative* structure of variability in the ancient crop yields from a particular area can be established may be established by extrapolation from modern data for the same area without estimating any *absolute* mean value.” The main environmental source of variability in harvest yields in Cyprus before the late 20th century was the severe droughts to which the island was prone. Christodolou described the effects of these in stark terms:

The most serious problem in land use in Cyprus and the most fundamental in the economy of Cyprus is the intractable problem of rainfall variability. A serious drought may dislocate all well-laid plans whether public or private, may seriously cripple the economy and causes untold suffering and in the past brought famine and emigration. In a serious drought the country's agricultural income may be halved

and capital (in the form of springs and wells which dry up, livestock which die, trees and vines which are killed) depleted. Recurring droughts have been the main cause of the perennial insolvency of farmers and of the generality and seriousness of indebtedness. But the main effect is psychological. An enterprise, like farming in Cyprus, with so many regular, if unforeseeable odds, is a big gamble and peasants face it with a fatalist outlook

-Christodolou 1959, 28.

Not only absolute yields but the structure of variability itself depends on environmental dynamics: more or less consistent rainfall, greater or lesser spatial variation in crop yields. Therefore, structures of variability identified on the basis of modern observations are subject to revision where proxy data for global climate or local environment indicate that conditions are likely to have been different in the past. This is in keeping with recent work in ecology which emphasizes the complexity of ecological systems. Turner (2005, 324) for example, has drawn attention to a series of simple modeling experiments by different workers which independently showed that stochastic variation in landscape processes was capable of producing non-linear relationships between landscape metrics.

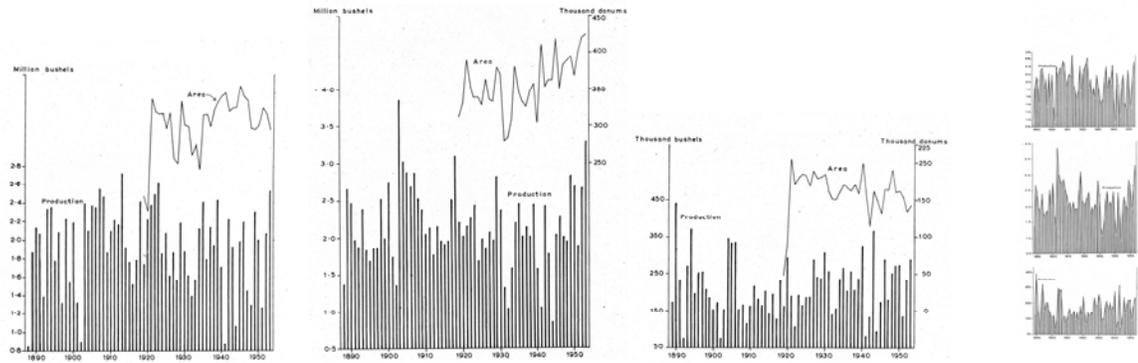


Figure 2. Interannual variation in yields of wheat, barley and vetches in Cyprus over the course of the 20th century (adapted from Christodolou 1959).

Because of the long chronological period encompassed by this study it is necessary to consider both global environmental change and local change in the vicinity of sites. Steven Held adopted the strategy of identifying modern day ecological zones which seem to have been especially important for prehistoric settlement (Held 1983), arguing that local ecological conditions can be projected back into the prehistoric past.

The modern climate of Cyprus has probably remained without secular changes since approximately the 8th millennium B.C., and the island's relief as well as weather conditions prevailing in the East Mediterranean must have had a stabilizing influence on the pattern of relative precipitation for even longer.

-Held 1983, 158

However, the argument that early Holocene climate was stable is untenable in the face of high-resolution data from Southwest Asia and the Global Circulation Models

(GCMs) constructed from these data (Alley et al. 2000; Robinson et al. 2006; Wasse 2007). There is a large body of recent work on both world climate change and acclimates in the Levant and eastern Mediterranean, nearly all of which suggests that global climate change had significant effects on regional conditions in prehistory, and that conditions were different than today. The literature is so large and some of it is technical, but Robinson et al. (2006) have assembled an extremely useful synthesis of different categories of paleoclimate data, both marine and terrestrial, in the eastern Mediterranean and Levant, drawing on and updating work over the last 25 years (including Alley 2000; Baruch and Bottema 1991; van Zeist and Bottema 1991; Rossignol-Strick 1995).

Robinson et al. conclude that proxy climate indicators in the Eastern Mediterranean correlate well, for the most part, with major Northern Hemisphere climate change as attested in ice cores; that records from pollen cores, spelotheims, marine deposits, and other proxies generally agree on the timing, if not the magnitude, of climatic change; and that outputs for the latest generation of global climate models (GCMs) such as HadAM3 (Pope et al., 2000) match well with proxy climate data, supporting the utility of these models (Robinson et al. 2006, 1537). They also offer some cautionary exhortations, including the importance of determining whether geographically disparate evidence (e.g. the Ghab Valley and Hula Basin palynological records) belongs to a single, synchronous climate event; how the Bøllering Allerød and Younger Dryas are related to the Last Glacial Maximum and the early Holocene, and the importance of seasonal factors, highlighted by the GCM, which are usually

invisible in sedimentary records—a subject to which I will return later (Robinson et al. 2006, 1537-1538).

The fact of long-term global environmental change does not mean the data about regional environmental conditions gathered by regional archaeological projects are useless: quite the opposite. Like historical meteorological observations, they indicate the different results of global changes for micro-regions: for rainfall, erosion, vegetation regimes, and their ability to support animal and human populations. Important studies by Robert King (1987, in Rupp et al. 1993), Wouter van Warmelo (2003), George (Rip) Rapp (2003), Steven Held (2003), Basil Gomez and J. Malcolm Wagstaff (2004), and Jay Noller (with Albert Ammerman, 2008) flesh out the picture provided by historical climate and meteorological data, which tend to have been gathered at ports and coastal population centers (see above). In the case of Cyprus, the strong altitudinal climate gradient means that these observations do not reflect conditions in the Mesaoria or the foothills of the Troodos. There are few palynological records for Cyprus, but comparison of the palynological record from Khirokitia against those obtained from Levantine contexts would suggest how different the conditions in the Maroni valley in the Aceramic Neolithic were from contemporary landscapes in the Levant.

Two of the most important categories of data are the fauna and botanical remains from excavated sites. While the Cypriot archaeological record does not speak directly to the *in situ* domestication of plants and animals (Croft 1993; Vigne et al. 2009; Willcox 2003; Colledge 2004), it does provide critically important information

about the dispersal of livestock and crops within Southwest Asia, and about variability

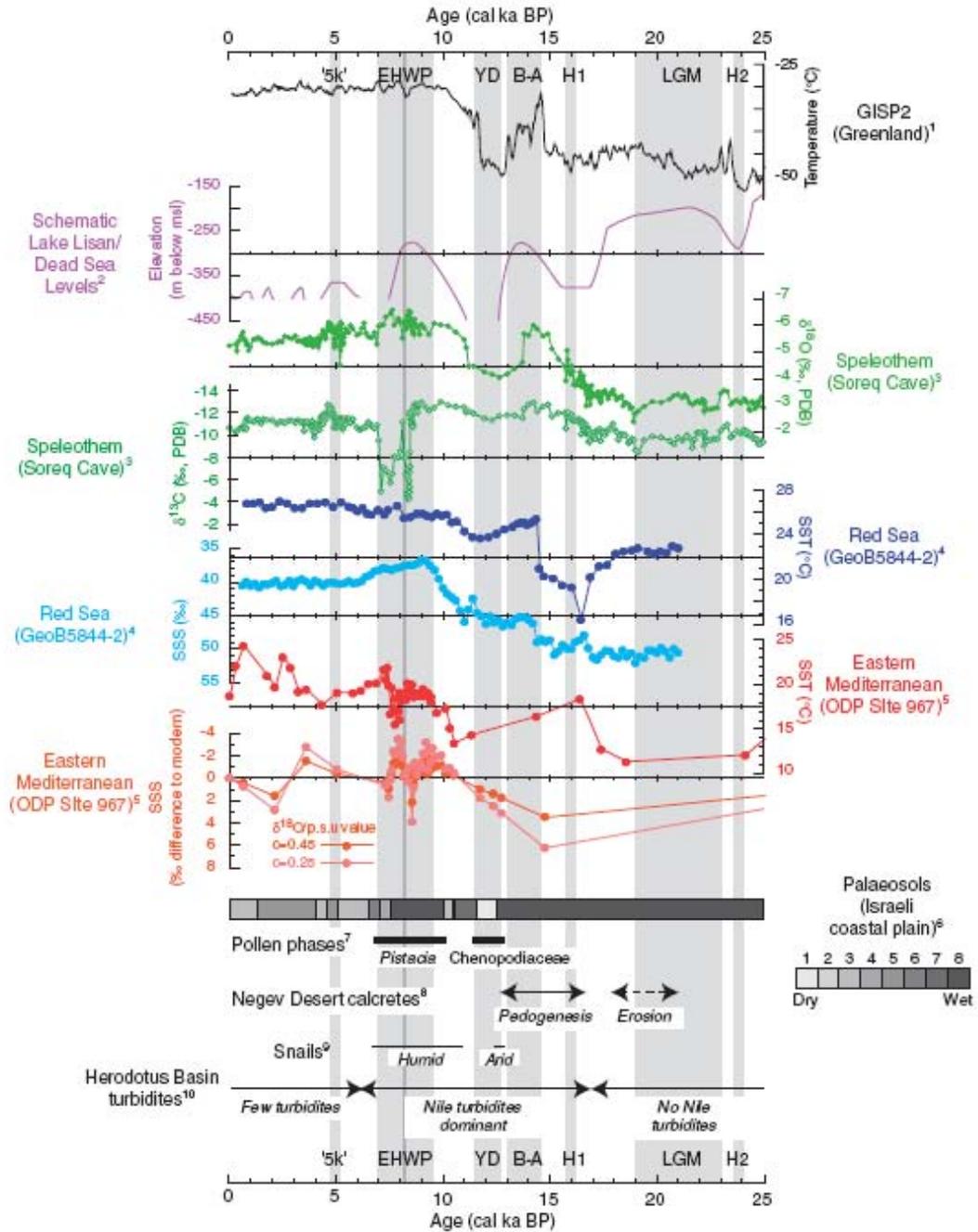


Figure 3: Proxy climate data for the Eastern Mediterranean in the Late Pleistocene and Early Holocene (adapted from Robinson et al. 2006: Fig. 14).

in early Neolithic subsistence strategies, which were presumably subject to strong selective pressures as the kinks in early farming were worked out under different social and environmental conditions (Broodbank 2006; Colledge 2004; Redding 2005; Wilcox 2003). Even where the relatively narrow suite of animal domesticates is concerned, people used many different strategies, some dictated by the necessity of protecting themselves from environmental risk, others driven by social concerns or demands made on them by hierarchical structures (Keswani 1994). In later periods, the ways in which animals were managed contributed to significant landscape modification in some regions.

On Cyprus itself, work on geomorphological change (King 1987), pollen sequences (Gifford 1978, Renault-Miskovsky 1987), and anthracology (Thiébaud 2003) are all valuable. Marine micro-organisms are an imprecise record for purposes of paleoclimate reconstruction on the scale of human generations due to slow sedimentation and bioturbation, while sea level changes are often ambiguous (King 1987, 8), and thus do not form a major part of this study. Despite erosion over the course of the Holocene and marine transgression at different times, the underlying geology, which is a major determinant of soil properties, is often very much the same today as in prehistory (Gomez and Wagstaff 2004). Soil properties are an especially important determinant of biomass when precipitation is reduced or highly stochastic (Huggett 1993, 154-7), but it is also necessary to take into account, insofar as possible, not only rainfall but evaporation, transpiration, runoff, and vegetation (Christodolou

1959; Held 1983). Both paleobotanical samples and pollen data from sites can help to identify sudden changes in local environment which may have constituted stress events (Renault-Miskovsky 1989). In his pioneering study of the Early Prehistory, Held recognized the possibility for paleobotanical assemblages to yield fine-grained data about subsistence practice, even if they had not yet done so:

As yet plant assemblages are too small to reflect statistically the importance of certain crops; however, on the basis of soil types associated with EP sites and of the variation in soil preference among different crop plants it can be estimated that wheat played a more important role than barley in the northern coastal plain at least during the early prehistoric period, whereas the opposite was possibly true of incipient cultivation on the fresh coastal alluvium along the southern seaboard. In other regions, the economic importance of wheat is likely to have equaled, and even exceeded, that of barley.

-Held 1983, 158.

Given improved botanical data, this is now a testable proposition (see Chapter 5). The use of different crops in different parts of the island would necessarily expose these geographical areas to different potential stressors.

Pollen has been under-studied in Cyprus, in part because alkaline and oxidizing environments in both modern and archaeological sediments inhibits preservation, in part because there are few lacustrine environments from which cores might be taken (King 1987, 7). As pointed out above, even where pollen preserved, it may not reflect vegetation changes, and vegetation changes do not always imply climate change. Gifford (1978) in discussing pollen in sediment cores from Larnaca, suggests that vegetation is a less reliable indicator of climate change in Cyprus than

elsewhere, due to an abundance of windblown pine pollen and "very site specific halophytic vegetation which made the pollen spectra of his core samples difficult to interpret" (King 1987, 8). Another problem is what King calls "the general insensitivity of vegetation to climatic and other environmental changes in the center of a major vegetation zone" (1987, 8).

Lamb has argued that temperatures during hypsithermal interval (7000-3000 BC), by which time climax forest was established in Greece and Turkey (Van Zeist and Bottema 1977, Bottema 1978), are likely to have been about 1-3 degrees higher than the present day. In the Eastern Mediterranean generally and Cyprus in particular, temperature fluctuations are less likely to have constituted a source of stress for early agriculturalists than precipitation, since rainfall below 200 or 250 mm/year will probably have led to failure of the wheat harvest (Gifford 1978), just as in the modern period. Additionally, however, rain had to fall at the right time: in 1943 the island received an adequate amount of precipitation overall, but the winter wheat harvest failed nonetheless because not enough of this precipitation fell in the autumn and spring (Christodolou 1959). Water sources are generally noted by survey archaeologists and excavators. Some, however, may have flowed more abundantly at different times in the past. While dependent primarily on precipitation, the flow of water courses and springs also depend on other factors including underlying geology (e.g. the presence of porous sedimentary limestone). In Cyprus, many water courses are seasonal, and in a dry year may not flow at all. This obviously creates the potential for the shortage of a critical resource. Superimposing Early Prehistoric sites on a map

showing perennial stream flow in the mid 20th century (Figure 4) reveals a high degree of overlap. Differences in stream flow in prehistory are difficult to investigate, but important to bear in mind.



Figure 4. Selected Early Prehistoric sites superimposed on modern perennial stream flow (data from Christodolou 1959)

In the early modern period, fire and locusts were both capable of destroying cereal crops in the fields (Christodolou 1959; Cavendish 1992). We can expect animal pests—rodents, birds, and insects—to have been a source of more or less constant attrition of stored food supplies in prehistory. Unfortunately, faunal data are usually inadequate to track the complex dynamic between different rodent species competing for access to humans' stored foodstuffs, though some work has begun to address this issue (Holt and Palazzo, in preparation).

Several workers have proposed catchment deterioration in the vicinity of Early Prehistoric sites (e.g. Wasse 2007). A reduction in the number and quality of locally available resources, and especially erosion tending to reduce the quality of both farmland and browse for animals, will have reduced the ability of people to respond to periodic stresses through diversification, and may have encouraged other responses such as mobility. The estimation of site catchment sizes and productivity necessarily involves a high level of expected error, but is still the best way of getting a general idea of the resources available within a certain distance from a known camp or settlement (Vita-Finzi and Higgs 1970; Wagstaff 2004). Archaeological geomorphology, particularly erosion and sedimentation, can provide evidence of local changes in a site catchment that might change the nature and frequency of environmental stresses. If it is suspected that geomorphological changes reflect deforestation or clearance for agriculture, they may be reflected in pollen and anthracological data sets as well.

Where human remains are available for study, they provide one of the most unambiguous lines of evidence for dietary change, nutrition, stress-related pathologies, and conflict. Burial practice also provides evidence for the existence of social roles and material inequalities often relating directly to the control of land, flocks, hunting territories, and subsistence resources. We cannot assume we ever have the entire dead population, and in Cyprus this is painfully evident, as at *Kissonerga-Mosphilia*, where the extent of the site in the Middle Chalcolithic may have been 8 ha., but only a handful of burials were found and no extramural cemetery, like those at

Souskiou, has been identified (Peltenburg 1998; Lunt et al. 1998). Change and variation in life expectancies, infant mortality, and other demographic metrics, used carefully, provides an additional source of information regarding the nature of environmental stress. Though Cyprus has a long history of bioarchaeological investigation, the potential of this evidence is only beginning to be fully exploited (Harper and Fox 2008).

If environment is taken to include humans outside the group under analysis, and if sites are taken as units under analysis, as in the present study, are then the question of population growth within regions requires consideration. A dense population of sites or large sites close together in an apparently “marginal” landscape is not itself strong evidence of susceptibility to resource stress. However, in combination with evidence for malnutrition or other signs of stress, it would naturally become more persuasive. Changes in the relationship between site size and density and catchment size and/or productivity are likely to be significant. Clearly, a larger site subsisting on a smaller or less productive territory is, all else being equal, more likely to experience resource stress.

In summary, independent evidence for stressors is desirable to avoid building a circular argument along the following lines: X represents evidence of a buffering strategy, from which we infer periodic stress Y, which must have been a response to X. In fact independent direct evidence of stressors is not always available, and in the case of Cypriot prehistory our knowledge of them is largely probabilistic, based on present-day structures of environmental variation, subjected where possible to checking

against available information about past climate globally and locally. This process allows us to understand better the structure of environmental risk faced by different groups on Cyprus between the eighth and fourth millennia BCE prior to looking for buffering mechanisms within the subsistence practice of different groups.

RISK-BUFFERING MECHANISMS, DISTRIBUTION IN SPACE AND TIME

As Halstead and O'Shea have urged, it is essentially to make clear the spatial and temporal scale on which buffering mechanisms under consideration operate. For example, arguing that the practice of polycropping is in part a response to interannual variation (Halstead 1987, Halstead and Jones 1995) is a different argument than polycropping is a response to global climate change. They are not mutually incompatible claims, but require very different evidentiary support. Recognizing that different buffering mechanisms will have operated on a range of temporal scales from daily to intervals of many decades, and bearing in mind the “nested” nature of such practices (Halstead and O'Shea 1989), it is probably impossible to recover from archaeological data the full range of buffering mechanisms employed by prehistoric societies in Cyprus.

All behavior to do with subsistence that can be identified from the archaeological record is worth considering, but much of this behavior will have served no buffering function whatever. Some behavior may have been genuinely maladaptive from an energetic standpoint, but presumably these behaviors were either abandoned or eventually led to strongly negative consequences for those pursuing them,

inhibiting or discouraging their repetition. Where farming or herding behavior is apparently inefficient in terms of its total return on energy, it may in fact have the effect of reducing risk, explaining—beyond the justification offered by farmers, “because our grandfathers did it this way”—why it persists (Forbes 1989).

It will be useful to characterize buffering strategies in terms of Halstead and O'Shea's four categories: mobility, diversification, exchange, recognizing that some specific mechanisms will combine two or more of these (e.g. mobility and diversification), while others (e.g. mobility and storage) are more difficult to combine. Additionally, it is highly desirable to ascertain the scale of the mechanism, whether it represents the behavior of a household, kin group, village, or indeed multiple villages, and its periodicity: how often the stress events occur whose effects are moderated by the mechanism.

Since evidence for different buffering strategies is unevenly distributed in space and time within the region of Cyprus and the periods under consideration, it is probable that the strategies themselves were so distributed. There will naturally be many cases where the absence of evidence (for storage facilities, for example) will not permit the conclusion that such a mechanism did not exist. Additionally, since foodstuffs are by nature ephemeral and residual traces of their presence often give little indication whether they were stored, exchanged, it will be necessary to depend to a large degree on proxy lines of evidence.

Proxy lines of evidence for mobility may include settlement patterns, the nature of sites, the nature of resources, faunal and botanical records, and evidence for

procurement of raw materials or items at a distance. None of these are themselves incontrovertible evidence for high mobility, but, especially where they occur together, are strongly suggestive. They also allow investigation of the spatial and temporal scale of mobility, whether daily residential moves of a few kilometers, or seasonal moves of hundreds of kilometers. Understanding how far and how often people moved around is essential to understanding the potential for them to move in response to environmental stresses. Low investment in permanent structures often correlates with lower site occupation intensity and higher mobility resources (Kelly 1995). At several points in the early prehistory of Cyprus, there is evidence for very ephemeral sites which suggest that part or all of the population was highly mobile.

The presence at a given site of evidence for resources which do not occur in the area of that site may be evidence for mobility or exchange. Where the remains of fish and marine invertebrates, for example, occur at inland sites on Cyprus, it is reasonable to infer that they were obtained directly, through exchange with groups adjacent to their habitat, or both. Reliance on hunted animals which move long distances is another sort of circumstantial evidence for mobility. In theory, it is possible for people to remain in one place and take advantage of the regular migratory patterns of animals such as birds or caribou, culling many of these animals at one time. However, this almost always requires good technologies for preserving meat in order to be a viable strategy, and few species which exhibit such migratory patterns appear to have been important in the diet of prehistoric people on Cyprus, with the exception of some migratory bird species, and those primarily in the Akrotiri phase.

Both faunal and botanical records can potentially illuminate seasonal activity at a site (cf. Wright et al. 1989). Some plant species can only be gathered in a given season (though some may be preserved); animals tend to migrate, give birth, or shed antlers during given seasons. Some kinds of procurement (fishing, gathering nuts) are likely to take place in given seasons or at specific times of year. While it seems probable that many of the sites considered in this study were inhabited year-round, some may have been used intermittently with low occupation intensity, and of these, some may have been related to seasonal procurement of resources. This is obviously important for understanding the nature of subsistence practice and risk in these societies.

Raw material transport also implies human movement: precisely whose is often difficult to say, nor is it easy to determine whether a given item was brought back to a site by a permanent inhabitant or exchanged hand to hand by many people over a long distance. Using raw materials as evidence of mobility requires the ability, at a minimum, to identify imports, and ideally, to determine their sources. For the purposes of this study, it will be useful to make reference to a few materials: obsidian, picrolite, and, on some sites where the ground stone assemblage has been examined, igneous rocks used for various implements.

Prehistoric people on Cyprus relied heavily on the high-quality cherts of the island, some of which can be identified based on the specific geological formations from which they derive, e.g., Lefkara basal (McCartney 2007). The distribution of chert sources is such that most prehistoric settlements were no more than a day's walk

from good sources of chert. However, chert apparently traveled much further, the length of the island. While Cyprus has so indigenous sources of volcanic obsidian, obsidian occurs on most prehistoric sites. Not only the presence of exotics, but how they were worked, can give us information about procurement and relations among communities both on and off the island. Cyprus has benefited greatly from specialist studies of lithic technology.

Picrolite, mentioned above, is a soft greenish stone used extensively in the Chalcolithic period, but also in earlier periods, for the manufacture primarily of objects interpreted as personal adornment (“pins,” or “brooches,”) and figural representations, primarily anthropomorphic in nature (Xenophontos 1991; Peltenburg 1991). Since it derives almost exclusively from one or two river valleys in the southwest of the island, its appearance at sites outside this region implies long-distance transport. This is more often taken as evidence of long-distance exchange networks than trips by people at other sites to the source. The ideological connotations of the material implied by its use almost exclusively in highly-finished objects of little apparent practical use may help explain why people were willing to go to such lengths, literally and figuratively, to obtain it. Significantly, finished items of picrolite do not seem to exhibit a “fall off” pattern as a function of distance from sources in the southwest of the island (Xenophontos 1991).

Ground stone derives from a multitude of sources of different ages, compositions, and properties (Elliot 1981). River beds are a primary source of the cobbles which were used to manufacture vessels and implements which, though they

often had complicated life histories of manufacture, breakage, modification, and multiple use or reuse, are often characterized as axes and adzes, pounders, grinders, querns, and so on. Multivariate studies of ground stone show that some kinds of stone were clearly preferred for some tool forms and applications (Elliott 1981), while not all kinds of stone were available everywhere. Therefore in some cases it may be possible to track mobility through procurement of cobbles for use as ground stone.

Group fissioning, whether ordinary, as often the case among mobile foragers, or extraordinary, as in villages, can also be considered under the heading of mobility. The periodicity of such fissioning is extremely difficult to determine in all the periods under consideration, but this makes a big difference for the structure of resource stress. Ethnographically, the greater people's investment in cultivation, architecture, and physical storage of surplus, the more traumatic fissioning seems to be, and the more extreme the social or environmental circumstances have to be before splitting the community is seriously considered.

Direct evidence for diversification, in the form of plant and animal remains, is easier to come by than that for mobility, but requires no less careful interpretation. It is often useful to compare the range of plants and animals represented at a site to those available in its surrounding region in the present day (e.g. Vita Finzi and Higgs 1970; Flannery 1972). Like optimal foraging theory, (Smith 1983; Kelly 1995), site catchment analysis is too often misunderstood. The goal of both is not to claim that people mechanistically followed an ideal strategy, but to begin to understand the potential for energetic returns from a given set of resources. Departures from the

“optimal” strategies predicted by such models provides a starting point for productive investigation of humans' participation in ecological systems.

Evidence for diversification in plant foods obviously comes from the range of edible plant remains recovered from sites. During the periods under consideration, cereals were probably always important relative to other plant foods, even if their relative importance may have varied (Held 1983, 158). Diversification in plant foods for early agriculturalists is often a matter of proportions rather than periodic recourse to a broad spectrum of wild plants. Additionally, it is difficult to separate the part of the plant assemblage being fed to animals and that being eaten by humans. Halstead records (Halstead 1987; Halstead and Jones 1995) ethnohistorical cases in which barley and even dried figs were considered unfit for human consumption, except in cases of extreme poverty or external stresses (war, drought). While they may be grown, or allowed to grow, as animal fodder, plants such as vetches can play an important role as “starvation foods” in extreme circumstances.

The faunal assemblage is highly sensitive to diversification. For much of the period under question, the animal economies of Cyprus might be characterized as relatively diversified, with hunting a major source of calories supplemented by stock-raising. The complex interplay between hunting and herding as complementary strategies deserves careful consideration. To what degree do the two strategies cannibalize one another, creating inefficiency, and to what extent are they complementary or synergetic in terms of obtaining a better return from the local environment while reducing risk?

Changes in the size or ages of hunted animals—particularly pursuit of a wide range of smaller game—is often an indicator of stress. Studies by Kristen Hawkes and others have consistently found that while hunting does not always provide the majority of calories in foragers' diets, it is important for subsistence as well as social reasons. While hunting large game represents a high-risk, high-reward strategy for individuals (*risk* defined here as the probability of a bad outcome, i.e., coming home empty-handed); this risk is moderated in most forager groups, as among the Hadza, by a strong sharing ethos (Hawkes et al 1989), and may in fact be beneficial for most of the members of the group. Hawkes and her colleagues conclude, based on observations of Hadza hunting and sharing practices, that “Big-game hunting and sharing provides more meat for everyone, just as the conventional wisdom would have it” (Hawkes et al. 1989, 87).

Throughout much of Cypriot prehistory, deer were effectively managed through a strategy that culled young males after a point where they would no longer gain weight quickly (Croft 1993). Departure from this strategy may indicate any of several (mutually compatible) possibilities: a superabundance of deer, such that management was unnecessary; use of a hunting technology (such as game drives, nets, or slaughter of whole herds) which did not facilitate age/sex specific culling; or a strategy maximizing short-term gains at the expense of longer-term efficiency. For example, Elder argued that the age/sex distribution of deer at archaeological sites in Missouri shifted from one resembling a population not subject to predation to a distribution in which the majority of animals were killed as young adults, and which

contained almost no old deer, reflecting much more intense, though apparently sustainable, human predation (Elder 1961). Where less age/sex discrimination follows on more “careful” management strategies, or accompanies changes in the transport of low-value parts of the animal (see below), or evidence for big increases in population within a region, it may indicate a response to stress. This has to be confirmed, however, by additional evidence.

The contributions of small game species relative to larger hunted species is difficult to evaluate due to issues of taphonomy and differential preservation. The bias towards recovery of larger, more robust bones (Croft 1998) has probably led to the underrepresentation of birds and the understatement of their importance as a food resource, especially in cases where large numbers (e.g. migrating flocks) could be taken at one time with nets, bolas, or other hunting technologies. However, changes *within* the small game fraction of animal economies can be equally illuminating. For example, Natalie Munro has used the small game fraction of the faunal assemblage at Natufian sites to demonstrate trends of intensification. She argues that several species, such as tortoise and hare, are unlikely to have experienced dramatic fluctuation due to interannual environmental changes or nonhuman predation. Among these prey species, tortoises require relatively less time and energy to catch and probably present a lower risk: they are “low hanging fruit.” Munro argues that where the small game assemblage at a site initially contains a high fraction of slow-moving small game but comes over time to be dominated by fast-moving small game such as hares, this shift reflects increased site occupation intensity: more people spending more time at that

site.

Just as some kinds of prey are preferred, some parts of large animals are worth the effort to bring back to camp while other parts (hooves, heads) are often not. An increase in the number of low-utility animal parts such as crania might reflect several different things. A first possibility is that hunters were less willing to abandon meat in the field. Presumably this would reflect the decreased abundance of game. A second possibility is that hunters were taking game close enough to the site that transport costs were low. In the absence of changes in settlement patterns, such as a shift to small camps, this is likely to imply that the prey species was more abundant. A third possibility is that labor requirements, food preferences or consumption behavior had changed.

Faunal taphonomy provides evidence for changes in processing which relate to diversification. Spiral cracking of long bones to obtain marrow and boiling of bones are two means of extracting important lipids. While often routinely consumed, a change from a low incidence of marrow extraction or boiling to a higher incidence may be plausible cause to suspect food stress. Bone assemblages on sites in Cyprus are often in poor condition, and taphonomy seldom yields useful information about changes in butchery technique.

Domestic animals are, naturally, also subject to manipulation; often, however, in ways that will be hard to detect archaeologically, as when they are fed different foods, kept in proximity to the settlement or grazed in outlying pasture, or “converted” to other resources through exchange with other households or communities (Halstead

1987). Throughout the period under consideration, the main domestic animals on Cyprus in terms of their representation by NISP were pigs, sheep, and goats. Cattle, while present at some Neolithic sites, were largely absent from Cyprus between the end of the Early Aceramic Neolithic and the Philia culture or Early Bronze Age. Pigs experience rapid weight gain, have a flexible diet, and produce large numbers of young. Sheep store fat efficiently, and, eventually, produced secondary products (milk and wool) of high quality and in large quantities. While prehistoric people on Cyprus may not have had the ability to digest raw milk as adults—even today, a high proportion of the population is lactose-intolerant—the conversion of milk to yogurt or cheese would have made it digestible. Goats will eat even thorny and resilient xerophilic plants and tolerate both rugged terrain and degraded landscapes better than other species.

The use of age/sex curves (Payne 1973) is a major source of information about domestic animal populations. Several features of animal husbandry practices in Neolithic and Chalcolithic societies on Cyprus which appear energetically inefficient may be aimed at buffering against risk. At many sites, culling of piglets before their major weight gain provided a source of meat year-round. A higher than expected proportion of male goats in some assemblages (Croft 1998) may indicate stock-raising in which individuals or households maintained their own, small flocks, similar to the fragmented land holdings in the Methana, which Forbes showed (1989) functioned to disperse risk. These all have to be considered in the context of their societies, alongside evidence for other buffering activities such as the storage of physical

surplus.

Storage of physical surplus, like diversification, is a common means of dealing with environmental risk within village societies. In the case of grains, this surplus included not only enough wheat and barley to meet people's needs until the next harvest, but enough to plant as seed; moreover, since any given season might produce low yields or fail, additional reserves would often be needed as emergency supplies and seed. Farmers following traditional practices in Greece often kept as much as a year's supply in reserve (Halstead 1987; Halstead 1989; Halstead and Jones 1995). There are any number of possible strategies for transporting and storing this surplus. Where storage facilities take the form of pits or granaries, they may be archaeologically recoverable, while baskets and wooden bins or chests are clearly less likely to survive under most conditions. With the advent of ceramic technology, large jars became an important method of storage over much of southwest Asia. The "Pithos House" at Kissonerga-Mosphilia held ceramic containers which could have accommodated thousands of liters of grain.

It is important to recognize that not all storage facilities were located in or adjacent to structures. For example, on Methana, people kept some surplus food in caches in natural caves and built hiding places, called *ambaria*, on hillsides away from the village, perhaps because these would be more difficult for raiders to find (Forbes 2007, 248-9). Greek farmers studied by Halstead often converted crops to silver, or silver to land, for strategic reasons (Halstead 1990). Halstead and O'Shea (1989) also draw attention to forms of "social storage," in which reciprocity and obligation can be

banked. Such a system would be particularly useful in a climate like that of Cyprus, where the spatial scale of environmental variability is small, such that neighbors may experience very different outcomes in a given year. Sometimes obligation is formalized through convertible tokens or valuable raw materials. It may be useful to consider some of the elaborate personal ornaments, highly polished ground stone artifacts, and (from the Chalcolithic) copper artifacts as possible evidence of buffering strategies which incorporated social storage.

For exchange, like mobility, we are heavily reliant on proxy lines of evidence. Raw material procurement has been addressed above; obsidian, diabase and other igneous rocks for ground stone tools, picrolite, carnelian, and other raw materials regularly traveled distances of hundreds of kilometers. For some foragers, long-distance exchange serves a critical function in promoting environmental monitoring and maintaining contact among maximal bands, which might have survival value. For agriculturalists, long-distance movement is a less common response to environmental stress, but where farmers live in relatively small groups e.g., of under 500 people (cf. Johnson 1981; Wobst 1974), there may be an advantage to seeking mates and making alliances externally (cf. Burch 2005).

Style and its role in communicating information and marking group membership and cultural boundaries is a major problem in archaeology. In the context of buffering strategies, stylistic aspects of material culture may provide information not only about exchange, but about people's movement, group definition on a variety of scales, often larger than that of individual sites, paths of communication, and

relations among groups. For the periods under consideration here, lithics and (from the start of the Ceramic Neolithic) ceramics are two classes of artifacts which are often considered in this regard (Clarke 2001, Bolger 2003, Clarke 2007a, McCartney 2007). The relationships among people suggested by the physical form of the things they made and exchanged will inevitably have affected other aspects of their behavior, including their attitudes towards risk and shortage. Similarity and dissimilarity of ceramic styles among sites may or may not be evidence of the breakdown of large-scale common identities in favor of regionally-based ones, or village fissioning (Clarke 2001; Bandy 2004). In this study, information about material culture style is used conservatively, and generally to suggest where, at a minimum, contact among groups existed.

In short, it is necessary to consider many categories of evidence in order to identify patterns of behavior which may have served as buffering mechanisms on different spatial and temporal scales. Ideally, there should be multiple lines of evidence to support the argument that a given behavior functioned as a buffering mechanism: first, independent evidence of the stress event to which the mechanism responded, including its likely duration and periodicity; second, evidence that the behavior could have reduced the impact of the stress event; third, evidence that the behavior was repeated at intervals commensurate with the frequency and duration of the stress event. However, evidence for these three things is hard to come by, given the nature of the sites in question and the way in which some of them were investigated. Just as conjectures need to be made about the nature of stresses (e.g., the probable

duration of droughts), so some conjectures need to be made regarding the effects of buffering mechanisms. These inputs are always subject to revision as more or better data become available.

It is highly desirable to characterize the distribution of identified buffering mechanisms within the region and over time, recognizing that most of the time there will be only weak negative evidence for the absence of certain mechanisms or (since they may have been in the “repertoire” but not deployed) for people's decision not to use them. At some times, as in the early Aceramic Neolithic, people at different sites apparently faced heterogeneous risks, and might not have had a shared “repertoire” of options, but for most of the Early Prehistoric the “repertoire” of buffering mechanisms was largely shared among villages across the island. Inevitably, which mechanisms were most often employed by a specific community will have differed according to local conditions, frequency of certain stresses, and availability of specific resources, such that sub-regions or villages found themselves depending far more heavily on one mechanism than their neighbors. This brings us to the fourth major question.

PATTERNED DIFFERENCES IN STRATEGIES AMONG VILLAGES

This question assumes that differences among village sites exist and are meaningful, rather than an artifact of site formation processes or sampling. It does not assume that either an individual village sites or the region of Cyprus constitutes a closed system, but seeks evidence for the nature of interactions, especially those which may have facilitated or inhibited strategies of exchange or mobility.

Where buffering strategies can be identified at some sites and not at others (sites, again, being the primary level of analysis in this study) it is reasonable to inquire why. In some cases the answer will be obvious: it is easier for relatively sedentary people at coastal sites who have some familiarity with marine environments to increase their use of marine resources, than for equally sedentary people living inland, who have less experience with marine environments, less specific knowledge of its resources, and lower investment in specialized technologies (boat building, net making). This hypothetical case does not exclude the possibility that the second group maintains the potential for mobility as a buffering mechanism; that they organize themselves in such a way that it is possible for them to move to the coast, or exchange for coastal resources. It does posit that people are generally most familiar with the environments in which they spend most time, have better information about the resources available in those environments, and are therefore more able to diversify procurement within them.

Some of the patterning in buffering strategies may therefore be due to cost structures. By their nature, buffering strategies nearly always involve energetic costs. Some strategies demand high initial investment (e.g. in the construction of storage facilities or wells); others incur variable time and opportunity costs depending on a host of factors, diversification being a good example. In some cases, costs may be obvious to agents (as with dispersed land holdings) and subject to manipulation. In others, especially where buffering mechanisms that operate at infrequent intervals are “embedded” in other social institutions, they may be all but invisible (Halstead and

O'Shea 1989). Similarly, presumably strategies confer differing degrees of benefit. One would therefore expect high-cost strategies which confer little benefit against infrequent stressors eventually to disappear, as people learn their energies are more productively invested elsewhere.

RELATIONSHIP OF SUBSISTENCE PRACTICE TO OTHER ASPECTS OF SOCIETY

The success and failure of different buffering mechanisms at different scales inevitably had consequences for social structures, institutions, and processes, but these were also affected by many other factors. Particularly of concern in this study are population growth (or lack thereof), feasting, social inequality, fissioning, ritual, and conflict (Price and Feinman 1995, Bandy 2004, Cauvin 2000, Carneiro 1970, Webster 1985). How did different buffering mechanisms affect population, insofar as it is possible to make inferences about changes in population given the nature of prehistoric archaeological data sets? To what degree did different buffering strategies permit the control and manipulation of resources by some members of or sub-groups within the community for their own ends? Did storage favor the development of asymmetric social relations among households or kin groups (Flannery 1972, 1993)? How do other buffering strategies affect processes of community fissioning--in the sense of "imagined communities," not merely physical aggregates of population (Bandy 2004)? Did preservation within ritual systems of mechanisms for dealing with stresses of infrequent periodicity (Minc and Smith 1989) produce variation among

ritual behavior, insofar as material results of that behavior can be observed in the prehistoric archaeological record? Was conflict over subsistence resources—not only food *per se*, but agricultural land, water sources, hunting territories and herds, flocks of domestic animals—a feature of Cypriot prehistory? If so, under what circumstances did it arise? These questions cannot be answered with reference to every mechanism discussed, but after reviewing evidence for subsistence practice in the Early Prehistoric of Cyprus, it will become clear that at several points, buffering mechanisms, as deeply entrenched repertoires of behaviors with high survival value operating within slowly changing social systems, contributed to important social changes.

Forbes has argued (1989, 97) that while those hazard-reducing or risk-buffering mechanisms embedded in institutions at the household level are “homeostasis-seeking,” those at the level of political units tend to be “deviation-amplifying” since they allow for the manipulation of surplus by ambitious members of the community seeking to create relationships of obligation and dominance (insofar as these confer additional security, they might be considered to fall under the heading of social storage). As pointed out by Arnold (1996, 5-6) and others, relationships between subsistence practice and increases in social complexity are not mechanistic and are rooted in local conditions; additionally, change can happen independently on several scales. However, the evidence from Cyprus generally supports the argument made by Brian Hayden (1996) that crisis events outside the range able to be coped with by normal buffering mechanisms may create conditions for rapid social change, including

increases in social differentiation and complexity.

RISK AND SUBSISTENCE PRACTICE IN EARLY PREHISTORIC CYPRUS

In order to answer the five major questions posed above, the remainder of this study has been organized as follows. Since, as argued above, variability is key to understanding pressures on subsistence practice and strategies, it will be necessary to review excavated sites and information from archaeological surveys on the basis of conventional periods. The next chapter, for example, concerns the Aceramic Neolithic, but not the earliest Aceramic (McCartney et al. 2007, Ammerman et al. 2008); rather the earliest well-documented agricultural village societies. The Ceramic Neolithic, for which there is somewhat less evidence, is treated in Chapter 3 and the Chalcolithic period in Chapter 4. Note that these chapters do not provide a comprehensive review of all sites or all surveys. Some sites are excluded on the basis of insufficient contextual information for archaeological material, or a lack of botanical and/or faunal data, as with Chalcolithic material from *Maa-Palaikastro*. There is no formula for approaching published sites in order to extract relevant information, but generally, the following subjects are discussed:

Botanical and faunal data provide essential information about the resources available to early agriculturalists in Cyprus, and what they did with them. Changes in the representation of individual taxa over the course of occupation are obviously highly significant at this scale. Other information for local environment in the form of geology and topography, modern vegetation regimes, and any anthracological or

pollen data are reviewed.

The built environment of these sites, while undoubtedly important, is treated in less detail. This is partly because it would be redundant and impossible completely to recapitulate all the architectural and stratigraphic information that typically form the bulk of archaeological publications. Partly, it is because of the difficulty of identifying units below the village level, and the danger of equating structures with kin groups (Adams 1973; Coupland 1996; Forbes 2007, 336-342; Souvatzi 2008). Physical storage features will always receive attention, though for reasons explained above, it would be unwise ever to assume that we have recovered all such features even from the excavated area of a site.

Some see social relations at the household level as necessarily linked to both production and increases in social complexity (Brumfiel 1992); others see these factors as decoupled (Arnold 1996). In order to understand the food ways that complement subsistence practice at the level of households and settlements, I review archaeological evidence for where food was prepared. Preparation is often a complicated set of practices. Procedures needed to render foods physically edible take on social significance, while additional procedures may be required to render foods culturally edible (Levi-Strauss 1970). Physical evidence consists largely of evidence for 1) grinding and pounding implements and 2) fires, including in Early Prehistoric Cyprus both hearths and ovens. Two problems immediately arise, since all the grinding implements in the periods under consideration are essentially portable; not all food needs to be subjected to cooking and not all fires are cooking fires. These issues

demand careful consideration of the physical and cultural context of hearths and ground stone. For example, where ground stone tools are found in fixed installations for grinding, in close proximity to hearths, it is reasonable to infer something like a “kitchen” area.

The particulars of consumption are equally difficult to infer from material evidence as those of preparation. Evidence includes bones, where disposed of (provided not excessively altered by canine or other scavengers); vessels, how big, and of what kinds; and any evidence from the location of cooking facilities and food remains for public (outdoor) or private (indoor) consumption, for small meals or feasts including the whole community. Even where evidence for consumption practice does not permit strong arguments about the social significance of food ways—and it often does not—it provides valuable context for subsistence practices, the “calorie getting” activities of prehistoric people.

Physical anthropology provides a certain amount of information about the age and sex structure of ancient populations. Physical anthropologists and archaeologists understand that numerous sources of error may skew attempts at demographic analysis: infants, for example, may be underrepresented in the dead population, or some community members' remains may be treated differently. However, it is worth noting that, for example, the methods used for calculating life expectancies yield similar results for populations for Chalcolithic populations on Cyprus even where sample sizes are small.

Physical anthropology also provides information about the life histories and

health (in vivo) of individuals. In the context of the present study, evidence for stature, violence, and pathologies of all kinds may be informative about the risks faced by prehistoric people. Particularly important is the ability of physical anthropological and mortuary evidence to corroborate . Where evidence for nutritional deficiencies co-occurs with paleobotanical evidence for degraded site catchments and exploitation of fast-moving small game, arguments for resource stress become significantly more robust. Or, where domestic architecture and storage suggest that a small group has greater access to resources, we might find nutritionally advantaged individuals in the mortuary record, possibly associated spatially or marked with particular kinds or quantities of archaeologically persistent material. Naturally, good recording of contextual information and good understanding of taphonomic processes are important for this kind of analysis.

Evidence for long-distance mobility and/or exchange potentially encompasses everything from the proximity of two apparently contemporaneous sites in complementary ecological zones to the presence of raw materials which much have originated at some distance from the location from which they were recovered.

In the following chapters, these various categories are not always presented in the same order, since the data are uneven; some sites are better discussed in an organic way. The first part of each chapter represents a review of relevant evidence, generally on a site-by-site basis and incorporating regional and environmental data. The second part of each chapter consists of a summary and brief discussion of the evidence reviewed: an overview of the variation in subsistence practice, what stresses can be

identified, and the identification of different subsistence strategies and buffering mechanisms. More in-depth analysis is reserved for Chapter 5, in which the “repertoire” of risk-buffering mechanisms, their spatial and temporal distribution, and the relationships between subsistence practice and social change can be taken up.

CHAPTER 3

SUBSISTENCE PRACTICE IN THE ACERAMIC NEOLITHIC

This chapter examines evidence for variation and change in subsistence practice in the Aceramic Neolithic of Cyprus (ca. 9000-5200 BCE). In the first part of the chapter, relevant faunal, botanical, and other environmental data are reviewed on a site-by-site basis, starting with the early sites of *Parekklisha-Shillourokambos* and *Kissonerga-Mylothkia*, moving on to the later Aceramic sites in the west and northwest of the island, such as *Krittou Mattou-Ais Yiorkis* and *Kholetria-Ortos*, then to the inland sites of *Dhali-Agridhi* and *Kataliondas-Kourvellos* in the northeastern foothills of the Troodos massif, concluding with the village sites of *Cap Andreas-Kastros* at the extreme end of the Karpass peninsula and *Kalavastos-Tenta* and *Khirokitia-Vouni* in the Vasilikos and Maroni river valleys of the south coast (see Fig. 5 below).

Change and development in subsistence practice and strategies at the site level are noted. The second section of the chapter addresses the nature of the resource stress faced by the inhabitants of Cyprus during the Aceramic Neolithic (Cypro-PPNB and Khirokitean) in a comparative and regional perspective, and reviews evidence for changes in their strategies for dealing with such stress.

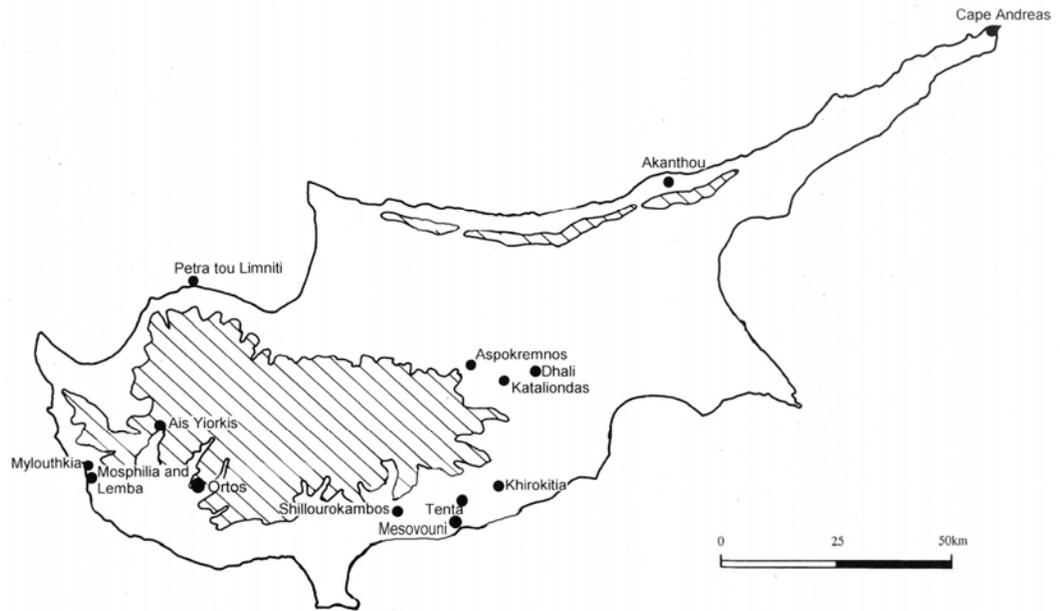


Figure 5. Map showing Aceramic Neolithic sites discussed (adapted from Clarke 2007a, Fig. 1.2)

Briefly, the Aceramic Neolithic is a period in which, despite unusual problems facing the earliest agriculturalists in this region, resource stress appears to have been relatively low and primarily of intermediate (seasonal, interannual, decadal) periodicity, adequately addressed through recourse to a broad diet which included many wild resources, through the social spacing of communities, and probably through mobility. Evidence for community fissioning (cf. Bandy 2004; Peltenburg 1993) is absent.

A substantial range of variation in practice is evident among the early farming

communities of the Cypro-PPNB, likely reflecting varying degrees of adaptation to local conditions, which were not uniformly ideal for cereal agriculture. However, nearly all Aceramic Neolithic communities on Cyprus apparently relied on cereal crops in conjunction with legumes, though agricultural practice will have differed in some important respects from “traditional” Mediterranean agriculture. Along with pigs, sheep, and goats, introduced fallow deer also became universally important. Towards the end of the Aceramic, village sites exhibit a transition away from hunting fallow deer to economies more reliant on herding ovicaprids, particularly sheep. While this has been argued to relate to environmental change or catchment degradation in the vicinity of these sites (Wasse 2007), independent evidence for change in the local landscape is inconclusive. Farming communities in Cyprus weathered the so-called 8.2 ka cold event without significantly altering their subsistence base or buffering strategies. The abandonment of the latest Aceramic village sites on Cyprus in the second half of the sixth millennium cal BC remains difficult to explain. While it is impossible to rule out a contributing role for environmental stress, neither the destruction of local ecosystems nor regional environmental change seems a wholly satisfactory explanation.

PAREKKLISHA-SHILLOUROKAMBOS

The earliest known agricultural settlement on Cyprus is Parekklisha-*Shillourokambos*, located on the present day coast (see Fig. 5), on a small plateau between two seasonal watercourses. It was recorded by the Amathus Archaeological

Survey and its size estimated at about 4 ha, though the excavators have revised this downward to about 1 ha, since much of the cultural material identified by the survey is now understood to have eroded downslope from the area of the settlement (Guilaine et al. 2000a, Guilaine and Briois 2001, Guilaine 2003). Shillourokambos is dated by a series of radiocarbon determinations to the 9th -8th millennia BCE, with several stratigraphic phases. The site gives us a partial picture of a small early farming community on Cyprus, even if the nature of the site and its stratigraphy preclude the identification of some indicators of stress and complicate the characterization of change over time.

In Chapter 2 it was explained why changes in diet breadth are often taken as evidence for periodic resource stress, as well as suggesting why other lines of evidence should be considered before making this inference. Neither the plant remains nor the faunal assemblage from Shillourokambos appear to reflect any very high level of stress. The botanical assemblage indicates that domestic cereals were important even at this early date, though supplemented with a range of wild plant foods. While calcium carbonate precipitation has affected preservation of organics, both emmer and einkorn wheat have been identified on the basis of impressions in baked clay (Willcox 2003). If Shillourokambos was founded by groups coming directly from the mainland, as is often assumed, the earliest farmers at the site might have experienced a period of adjustment and higher vulnerability before they discovered the most favorable locations for their cereal crops (Willcox 2003). The same applies to location of wild resources. Willcox has argued that the wild barley identified at the site might indicate

the exploitation of native stands of wild barley, the only wild ancestor of domestic cereals that grows wild on Cyprus today, perhaps as a hedge against the failure of domestic cereals (Willcox 2003, 237). This hypothesis would be strengthened by evidence of other risk-reduction strategies.

It is difficult to say which wild foods were most intensively exploited, what was their relative importance, which ones would have been regularly used on a seasonal basis, and which, if any, represent “starvation foods.” Present day vegetation around the site includes oak and wild olive, which produce acorns and olives high in calories and lipids. Anthracological studies by Thiébaud (2003) also indicate the presence of these species in prehistory, but suggest that their relative importance may have changed during the course of the aceramic Neolithic, with olives increasing dramatically while oaks remain fairly constant over the course of the occupation of the site.

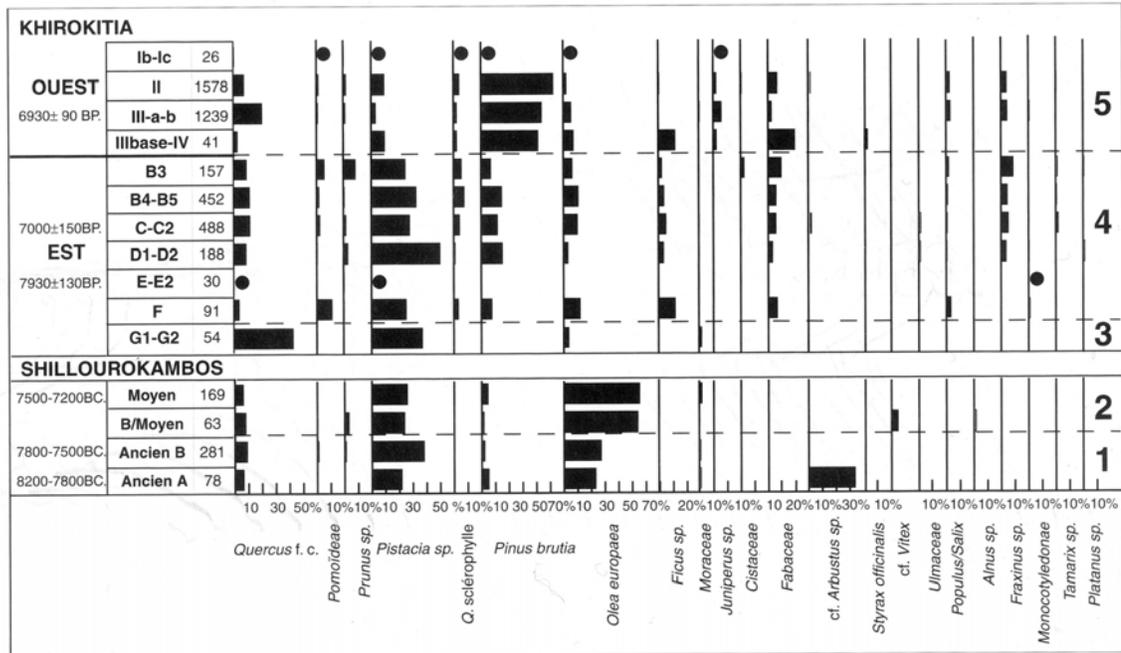


Figure 6. Anthracology diagram for Shillourokambos and Khirokitia (adapted from Thiébault 2003, Table 2)

While this study is valuable, a few caveats apply. The study was based on 870 samples, with Early Phase A represented by only 78 (Thiébault 2003, 223, Table 2). Furthermore, the proportion in which wood belonging to different species was burned and deposited in the archaeological record does not necessarily indicate the proportions in which these species were represented in the landscape, nor does it tell us about the proportions in which their edible products were consumed. However, it can reveal differences between modern and ancient environment in the kinds of trees represented: the presence of ash, for example, suggests a more mature and well-watered woodland than presently exists in the vicinity, while fruit and nut-bearing trees, though they appear in such low numbers in the anthracological database, would

have been a valuable addition to the prehistoric diet.

If we are prepared to accept that charcoal samples reflect the representation of different kinds of trees in the vicinity of a site, within a certain relatively wide range of error introduced by differential selection, deposition, and preservation, then changes in the representation of tree species from one phase to another provides valuable information about the availability, if not the exploitation, of those trees' edible products. The levels of *Pistacia* in Early phases A and B are about the same as those in the Middle phase, but proportions of *Olea* increase significantly, from <30% of samples in both Early phases to around 60% in the Middle phase (ca. 7500-7200 cal BC) (Thiébaud 2003, Fig. 2). As Thiébaud points out (224-227), such high levels of *Olea* are rare not only on Cyprus but in Southwest Asia before the Bronze Age. *Quercus* remains under 10% in all periods. The implications of the anthracological data from Shillourokambos and Mylouthkia for local environmental change are discussed more fully below and in Chapter 6. For the moment it is sufficient to say that they suggest the feasibility of a broad diet including the exploitation of wild plant foods, the best represented of which are wild olives, which come to prominence in the Middle phase, but possibly also including almonds, acorns, wild pistachio or lentisk, and sloe berry.

The Shillourokambos fauna are unusual for aceramic Neolithic sites in Cyprus in exhibiting generally good preservation (Vigne et al. 2003, 241). They are relevant well beyond the limited scope of the island since they provide information about animal management and domestication at the end of the 9th millennium BCE (see, e.g.,

Horwitz et al. 2004; Vigne et al. 2009). Here I am concerned here primarily with what they indicate about the environmental risks and stresses experienced by early farming populations on Cyprus, and secondarily if at all with their relevance for the spread of farming.

It is important to recall that at this time in human prehistory, many people may have lacked the enzymes required to digest lactose as adults, and would not have been able to take direct advantage of one of the most important 'secondary products' yielded by domestic ungulates, milk, though processing milk into yogurt or cheese renders it more readily digestible. Herded animals thus represented primarily a “walking larder” (Clutton Brock 1990) which gave farmers increased control over the spatial and temporal availability of meat.

The animal species represented at Shillourokambos are presented in Table 2 (data are taken from Vigne et al. 2003, 240, Table 1). Vigne et al. (2000, 2003) have discussed the implications of the Shillourokambos fauna at length, and the following discussion relies heavily on their interpretation. Before using these data to look for risk-buffering strategies or evidence of stress, it is important first to note that the fauna listed above are believed to have been introduced by humans, in various stages of domestication; some probably became feral after their introduction (Croft 1993, Vigne et al. 2003). Simmons' claim that “the endemic fauna had been all but eradicated” (2003, 69) is somewhat hyperbolic, but endemic (mini) megafauna such as pygmy hippopotamus had apparently disappeared from Cyprus by the end of the Pleistocene, and it is probable that early Holocene settlers of the island encountered an

environment with few terrestrial megafauna (Simmons et al. 1999) into which it was advantageous for them to introduce large animals as sources of meat (Croft 1993).

The Shillourokambos pigs are on average smaller than wild boar in mainland SW Asia and apparently did not change significantly in size over the occupation and use of the site (Vigne et al. 2000; Vigne et al. 2003; Vigne et al. 2009). There may, however, have been two populations of pigs at the site: one domestic and slaughtered at 1-2 years, and one of hunted feral animals, often killed at a more advanced age, butchered in the field and therefore contributing few teeth (a diagnostic marker of both size and wild status) to the faunal assemblage at the site (Vigne et al. 2003, 243).

The importance of pigs in the earliest phases of the Cypriot Aceramic Neolithic and their apparent replacement by other taxa in subsequent phases has been remarked on by Alex Wasse (2007). True to this pattern, Early phases A and B at Shillourokambos see an apparent shift from a high percentage of suids to a heavier reliance on fallow deer, sheep/goat, and a not insignificant fraction of cattle. Cattle are unusual for the neolithic of Cyprus, though they are attested at other sites in the western part of the island.

Mesopotamian fallow deer (*D. dama* or *Dama mesopotamica*) were widely hunted on the Levantine mainland in the Epipaleolithic, but Natufian and Neolithic people in the Levant relied more heavily on gazelle. Given this pattern, it is interesting that the early Holocene human settlers of Cyprus apparently chose fallow deer rather than gazelle to “re-stock” the island. It is possible that the groups which settled Cyprus came from areas in which fallow deer were still the most important prey

animal, or in which gazelle were rare. Fallow deer remained an important resource on Cyprus for much of prehistory (Croft 1993).

Vigne et al. argue that the deer from Shillourokambos exhibit an age distribution close to that expected in a population not subject to predation (2003, 245). They infer that there was no selective strategy, nor were herds actively managed, as proposed by Carter (1989) and Davis (2003); rather, hunting apparently targeted whole herds of deer, which tend to be gregarious where open woodland environments permit (Chapman and Chapman 1975).

Taking large numbers of animals at one time is neither inherently risk-averse nor inherently risky. Where large and predictable concentrations of animals occur only seasonally, for example caribou in Arctic environments or salmon in the Pacific Northwest, mass killing strategies are sometimes used (Kelly 1995). However, it is generally disadvantageous to kill many more than can be preserved by cold storage, drying, smoking, or salting. On Cyprus, however, there is no reason to suppose that deer were available only at certain times of year, and taking whole herds (or their members individually but indiscriminately with regard to age and sex) is suggestive of a relatively low level of risk aversion in hunting practice, as opposed to, for example, a strategy in which male deer are selected while breeding females are allowed to survive and have more offspring.

Cattle represent 3% of the faunal assemblage by NISP at Shillourokambos in the Early A phase and 9% in the Early B phase. At about the same size as wild aurochs, these cattle were very large. The apparent selection of younger animals (1-4

years), and the presence of nearly all elements on site have been argued to indicate that they were bred and subject to human management rather than a wild, hunted population (Vigne et al. 2003, 248). If raised for meat, as suggested by Vigne et al. (2003, 248-9) based on epiphysal fusion, the Shillourokambos cattle will have contributed calories out of all proportion to their percentage representation by NISP. Though cattle were probably not used for traction at this time, they might have also have furnished milk, digestible in the form of yoghurt or cheese even by lactose-intolerant people (then, as now, likely to have been a high percentage of the Cypriot population), or an often-overlooked secondary product in the form of blood, as do the cattle of Masai herders in Africa (Hanley 1971). I follow Vigne et al., however, in assuming their major contribution to diet was in the form of meat, of which a single bovid would have provided an enormous amount, more than 200 kilos or over 400,000 calories. The sheer size of such a caloric package may have contributed to the ideological importance attached to large quadrupeds in Neolithic communities in Anatolia. In the very small villages of Aceramic Cyprus, however, enormous caloric packages may have been less useful: the faunal assemblages of the Middle and Recent phases reflect a decline in cattle to <1% NISP (Vigne et al. 2003, 248).

Sheep and goats at Shillourokambos increase over time as a percentage of the total faunal assemblage by NISP. Some of these are probably wild (i.e., feral) ovicaprines, the ancestors of the modern wild moufflon. Indeed, Vigne et al. (2003) have suggested that a third of all the caprines represented in Early Phase B were hunted. Among those identifiable to sheep or goat, age and sex distributions reveal no

selective strategy for goats, which additionally exhibit strong sexual dimorphism and scimitar-type horn cores, suggesting to Vigne et al. that they were mostly wild and hunted (2003, 247). Sheep, on the other hand, appear to have been managed as early as Early phase B, according to a strategy in which (disproportionately male) lambs were culled at 2-6 months and adults anywhere from 4-10 years; oval horn cores suggestive of human management appear in Early phase B and increase in frequency in later phases (Vigne et al. 2003, 247). Wasse has argued (2007) that raising fast-reproducing domestic stock (sheep/goat) offers the greatest potential for intensifying production of animal fat and protein. There is minimal evidence for this sort of intensification any time before the Recent phase at Shillourokambos, when ovicaprids reach 46% of NISP (Vigne et al. 2003, 240, Table 1).

The role of transport in affecting the representation of some elements, teeth of pigs and heads and horns of goats, has already been discussed. It is unsurprising that heavy crania were apparently left in the field. It is not impossible that tongues and other meat from the heads of pigs (larger and more meaty than those of deer, sheep or goats) were consumed away from the site. Foragers and collectors will often eat some parts of their kill in the field, including high-fat parts such as organs or long bones (Frison 1978; Speth 1990; Kelly 1995). Vigne et al. did not identify any change in the transport of low-utility parts of hunted animals over time.

Data for the small game fraction of the faunal assemblage are lacking. A small number of fish remains have been recovered and analyzed by Desse and Desse-Berset (2003). Apart from some ray spines, these have been identified as grouper

(*Epinephelus*). This fish is hermaphroditic and the samples seem all to belong to large males, perhaps 80 cm long and greater than 10 kilos. In the northern Mediterranean, this pattern has been argued to reflect cold water temperatures inhibiting reproduction, but since a greater size range of groupers is attested at Khirokitia and Cap Andreas-Kastros (see below), Desse and Desse Berset argue that the inhabitants of Shillourokambos may deliberately have been selecting larger individuals (2003, 289). This reinforces the general impression of “affluence” in the animal economy of Shillourokambos.

To summarize the faunal data, an early reliance on suids, both managed and feral, on cattle, and on deer gave way to a strategy in which hunted deer, pig, and goats were major contributors to diet alongside domestic sheep, pigs, and cattle. Only in the Middle or Recent phase did animal husbandry of ovicaprids become the primary source of calories, and even then hunting was still a major source of meat, though a less predictable one than animal husbandry. The decrease in the contribution of wild boar to diet from Early phase A to Early phase B, the apparent absence of selective criteria for deer and goats throughout, the apparent selection of only the largest male groupers, and the taking of fallow deer either in herds or indiscriminately with regard to age and sex, all imply a relatively low level of risk aversion in hunting strategy.

Unfortunately, the published physical anthropological evidence from Shillourokambos is a wholly insufficient basis on which to assess nutritional stress or deficiencies. The eventual publication of the human remains with evidence for caries, injuries, disease, and work-related pathologies, will provide evidence for both daily

life and the nature of nutritional stress in this Cypro-EPPNB community. They already provide evidence for ritual or belief relating to human ecological relationships. A deep pit (Structure 23) belonging to the Middle phase at the site, ca. 7500 cal B.C. contained a large deposit of mixed human and faunal remains (Crubézy et al. 2003). The deposit does not seem to have been a waste pit; rather, deer, piglet, and sheep/goat bones seem to have been deliberately deposited alongside with the partial remains of multiple people (Crubézy et al. 2003, 298). Similar practices are not unknown in the Levant, for example at the PPNB mortuary site of Kfar Hahoresh in northern Israel (Goring-Morris et al. 1998; Goring-Morris and Horwitz 2007). At a time of profound changes in symbolic behavior (Cauvin 1972), it is important to recognize the potential for ritual to shape and respond to risk management strategies (Rappaport 1967; Minc and Smith 1989).

Storage arrangements are unfortunately not apparent at Shillourokambos. The deep pits on site have not been interpreted by the excavators as storage features, but it is always possible that surplus cereals were stored in these or similar features. Likewise, we have little evidence for the degree to which mobility and long-distance contacts with other groups might have been used to buffer against bad years. As discussed above, mobility is not generally considered a viable risk-reduction strategy for a whole community of villagers presumed to be dependent on cereals. However, selective mobility on the part of even some community members, perhaps those with long-distance kinship ties to other communities where they could expect to be fed, could have reduced the effects of negative environmental variation. The excavators of

Shillourokambos have pointed to the glossed obsidian crescents at the site as suggestive of connections with mainland Anatolian, the nearest source of volcanic obsidian (Guilaine 2003). Overall, however, there is insufficient evidence to argue that either storage or long-distance contacts must have been used to moderate subsistence risk at Shillourokambos.

Thiébaud (2003) has used her anthracological analysis to advance a reconstruction of vegetation in the neighborhood of Shillourokambos. The high representation of wild olive has already been discussed above. In Early phases A and B samples also included pistachio, wild olive, deciduous oak, black pine, ash, alder, and almond or blackthorn (sloe). Thiébaud reasonably interprets these (2003, 224) as reflecting an open steppe forest. However, certain of these species may reflect riparian vegetation associated with the streams close to the site. Water is obviously an indispensable resource, and these streams were clearly a factor in attracting settlement. Even under a milder climate regime than the present day, their flow will have been both seasonal and variable in volume according to the timing and volume of snowmelt and runoff, and this in turn will have affected not only the success of cereal harvests, but the availability of certain wild resources, fodder for animals, and the amount of water available for human and animal consumption (for seasonal and perennial flows see Christodolou 1959, 114-120). The intensification of ovicaprid husbandry in the Late phase may have had some effect on the local vegetation, depending how large a wild ovicaprid population was present and how domestic animals were housed and fed: whether kept primarily in pens and fed on fodder, or turned loose to browse the

local vegetation. Unfortunately there are no anthracological or pollen data with which to contextualize this shift to more intensive ovicaprid husbandry.

In general, therefore, the evidence support a relatively low level of resource stress, and there is little evidence for an increase in stress over time. The overall picture is of a small farming community reliant not only on its domestic cereals and livestock, but taking full advantage of wild resources in its surround. It is instructive to contrast Shillourokambos with the admittedly still more patchy evidence from Cypro-EPPNB Kissonerga-*Mylouthkia* nearly 75 km to the west, on the modern-day coast.

KISSONERGA-MYLOUTHKIA

The Aceramic Neolithic settlement at Kissonerga-Mylouthkia (map, Fig. 5) is represented only by wells cut into the *havara* bedrock, 'curvilinear structure' possibly representing an eroded building, a hearth (Croft 2003, 273), and pits; no other structures or large-scale features have yet been found. To judge from Early Phase A at Shillourokambos, such structures may have been ephemeral or non-existent: the "early village" societies of Cyprus seem to have been prone to dispense with the "village" part of the equation. Unlike the wells at Shillourokambos, dug into gravel beds where groundwater collected, those at Mylouthkia were placed directly atop underground watercourses with what seems like preternatural skill (Croft 2003, 272). The excavators have dated the deposits in Well 116 to a Cypro-EPPNB phase, ca. 8000-8400 cal B.C. and those in Well 133 to a Cypro-LPPNB phase ca. 6800-7300 cal B.C.

(Peltenburg et al. 1998, Peltenburg 2003). Wells 110, 2030, 2070, and 2100 are also believed to contain deposits of Cypro-PPNB date (Peltenburg 2003).

The nature of the site makes the assessment of diet breadth extremely tenuous. The deposits at the base of Well 116 contain domesticated cereal crop seeds, deposited while the well was still in use, einkorn and emmer wheat, hulled barley, lentils and other nitrogen-fixing legumes, and weeds commonly found alongside cereal crops (*Lathyrus* sp, *Vicia* sp.) (Peltenburg 2003, 24, 28). This reinforces the evidence from Shillourokambos that Cypro-EPPNB settlements were well provided with domestic cereals, all of which remained in use throughout the Aceramic at nearly all sites.

Animal species present in well 116 include deer, pig, caprines, cat, birds, limpets, freshwater snails, and edible marine mollusks, as well as fish remains, including some identified as horse mackerel (*Trachurus*). Both caprine and pig remains are present in relatively small numbers in Well 116, and the fill of a single well is arguably unlikely to reflect the relative proportions of animals consumed by the Mylouthkia villagers. The remains of numerous small animals were recovered in the excavation of the Mylouthkia wells. Some are certainly invasive: creatures that fell into the wells, were trapped, and died there, or which burrowed into the deposits and died underground. Others probably represent the discard of food remains (Croft 2003). Birds, particularly, are less likely than small rodents to represent accidental victims. The presence of the house mouse among the small rodents indicates the early speciation of this taxon and its status as a fellow traveler with humans and their stores of grain and seeds (Croft 2003, Cucchi 2001).

Well 133 dates to the Cypro-LPPNB. One of the most striking features of the later well is the deposition of 23 complete sheep and goats (Peltenburg 2003; Croft 2003). These were found in association with human remains, some apparently with soft tissue still attached (since mandibles and skulls were found together). Edgar Peltenburg has argued that the skulls were arranged around the perimeter of the well shaft while the animal carcasses were dumped in the center; he has suggested (2003, 27) that this might have formed part of a site abandonment tradition. Human and animal bones were also associated at Shillourokambos (see above). While Paul Croft also favors this interpretation, he acknowledges that it is difficult to rule out “an act of desecration of the dead and wanton slaughter of livestock” (2003, 273). While evidence for violent conflict among villages on Cyprus in this period is minimal, its existence cannot be dismissed out of hand. In many other early village societies, archaeologists have found that “intervillage raiding had begun almost as soon almost as soon as there were neighbors to raid” (Flannery and Marcus 2005, 99; cf. Carneiro 1970; Keeley 1995). Well 133 contained a stone artifact identified as a mace head (Peltenburg 2003). Such a mace would have made a formidable weapon, as would the arrows for which the chipped stone points at Shillourokambos (Guilaine 2003) and Ayia Varvara (McCartney et al. 2007) were presumably made, though it could just as easily have been a tool. Later “mace heads” have been recovered at other Aceramic Neolithic sites including Kataliondas *Kourvellos* and Kalavasos *Tenta*.

Janet Ridout-Sharpe (1998, 2003) has argued that the “smaller than normal” size of the limpet shells from Mylouthkia reflects the results of human exploitation.

There appears to be no evidence for increase or decrease in the intensity of their exploitation over time based on the number of shells (Ridout-Sharpe 1998, 225). However, if either a reduction in size over time could be demonstrated, or a difference in size between the limpets at Mylouthkia and those at other sites, this might be taken as circumstantial evidence for human over-exploitation of local limpet populations.

In Stratum 2 (the post-hippopotamus level) at Akrotiri-*Aetokremnos*, both birds and shellfish were heavily exploited (Simmons 1999). This assemblage is primarily (96.2%) topshells (*Monodonta*) and limpets (*Patellidae*) account for almost all of the rest (3.9%)². Extraction procedures (topshells were smashed, limpets were opened using another shell) were essentially the same at Aetokremnos as at Cypro-EPPNB Mylouthkia, and preparation also appears to have been similar, to judge from the burn marks on shells at both sites (Reese 1999, Peltenburg 2003, 25). It is probable that any number of molluscs were eaten elsewhere, perhaps on the beach, and not deposited in the wells (Ridout-Sharpe 1998, 225).

No data for the distribution of limpet shell sizes at Aetokremnos have been published, but the apparent shift from a topshell-dominated mollusc assemblage at Epipaleolithic Aetokremnos to one in which limpets and topshells are approximately evenly represented in the Cypro-PPNB and later at Mylouthkia is itself interesting. It would seem that topshells were either highly preferred or disproportionately abundant compared with the other marine molluscs available near Aetokremnos, while at

² I assume the analyst, David Reese, has rounded up these percentages, since they total over 100% before taking into account the other shells at the site.

Mylouthkia these two kinds of molluscs were equally abundant, or the less abundant, whichever that was, was preferred. It is possible that over-exploitation of limpet populations by humans in the Epipaleolithic and perhaps in the Cypro-PPNA put stress on those populations which is reflected in fewer limpets being taken at PPNB Mylouthkia relative to other marine invertebrates and in the overall smaller size of these limpets, with correspondingly diminishing returns for humans. However, there are insufficient data to adequately examine this hypothesis.

The artifacts of chipped and ground stone and bone found in the wells shed light indirectly on the subsistence strategy of the Mylouthkia villagers. A bone fishhook (Peltenburg 2003) reinforces the impression of investment in marine resources. Equipment generally thought to have served for processing plant foods—querns, rubbers, mortars, pestles—occurs with low frequency compared with relatively elaborate stone bowls (Peltenburg 2003, 29, Table 2). Presumably these artifacts were produced on site at the as-yet undiscovered settlement associated with the wells. The many stone bowls deposited in the wells might have been manufactured very close to the wells, perhaps because large quantities of water were required for their production (Peltenburg et al. 2001, 49). Investment in polished stone vessels is reasonably taken to reflect high site occupation intensity and investment of energy in pursuits that did not directly generate more calories.

If the flora, the faunal assemblages and the human remains from Mylouthkia offer little firm evidence for resource stress beyond the apparently runty size of the limpets, the site's location and the investment of considerable labor in digging

deep wells are both noteworthy. While there has been marine transgression along the south coast on Cyprus generally since the early Holocene (Gomez and Pease 1992), it is uncertain whether Myouthkia was on the coast in prehistory, or inland, overlooking a flat coastal plain between it and the sea (Peltenburg 2003). Mylouthkia is situated at a geological boundary between a river-fed coastal plain to the north and the Ktima lowlands to the south, which contain natural springs (Peltenburg 2003, 18). It is therefore not optimally placed with regard to the water resources in the neighborhood, which were utilized by the Chalcolithic sites of the Lemba cluster (Peltenburg 2003, 18, and see discussion in Chapter 5). It is probable that this zone between the Ktima lowlands and the narrow coastal plain to the north represented an ecotone, a transitional zone between two ecologically distinct areas, though the vegetation of the Early Holocene Wet Period may have been substantially different than today's (Luz 1982; Bar-Matthews et al. 1999; Frumkin et al. 1999; Alley et al. 2006).

Anthracological evidence from the Mylouthkia wells indicates the presence of oak and lentisk, but not of pine or olive (Peltenburg 2003), suggesting a vegetation regime unlike either the modern vegetation or that attested at Shillourokambos. Presumably the marked contrast between Shillourokambos and Mylouthkia reflects either depositional factors or micro-regional variation in vegetation observed in the modern Mediterranean (Grove and Rackham 2003). If the latter, there are important implications for settlement choice, the spread of farming and farmers, and inter-community relations, all problems of interest in the study of early farming villages: these are discussed below, in Chapter 6.

While Level V at Kalavassos-Tenta is also to be assigned to the Cypro-EPPNB, the environmental evidence from that level is minimal. It is better to move to the Middle and Late Aceramic Neolithic, beginning with the sites of Kholetria *Ortos*, Krittou Mattou *Ais Yiorkis*, Kannaviou-*Kochina* and Kedaress-Yero *Vasili* (see map, Figure 5).

KRITTOU MAROTTOU AIS YIORKIS

Krittou-Marottou *Ais Yiorkis* is situated about 19 km from Mylouthkia. It has been investigated by Nicholas Stanley Price (1979) in the 1970's, the Canadian Palaepaphos Survey Project (CPSP) in the early 1980s, William Fox in 1982 (Fox in Rupp et al. 1984, Fox 1987) and by a team from the University of Las Vegas in the 1990s (Simmons 1998a, 1998b, Simmons 2003). It is unusual among Early Prehistoric sites in being 460 meters above sea level, within the vegetation zone described by Held as climax veg zone 4: "Upland Forest of Aleppo Pine, Hermes Oak, and Wild Olive," a precipitation zone receiving 600-700 mm a year, and in a soil zone characterized as "Deep Silicate Raw Soils on Mamonnia rocks" (Held 1992, 149).

Relatively small-scale excavations by a team from the University of Nevada at Las Vegas uncovered a wall and deposits of chipped and ground stone and bone. The chipped stone assemblage is heavily biased towards tertiary flakes and blades, to a much greater extent than at *Ortos*, suggesting greater off-site processing, though again this is based on a small excavated area (Simmons 2003, 66). It is possible that the differences in the lithic assemblages reflect differences in site function, a point to

which I will return below. No botanical remains have yet been published, while the faunal assemblage is based on a small number (340) of identified fragments. The percentages are reflected in Table 2, below. The most striking aspect of the faunal assemblage is the presence of cattle (Simmons 2003, Croft 2003). A 14C date of 7007-6468 cal BC obtained from one of the excavated cattle bones confirms that they are not intrusive.

KHOLETRIA-ORTOS

Kholetria-*Ortos* is 17 km south of Ais Yiorkis and about 10 km from the present day coast, overlooking the Xeropotamos river valley (Croft 2003, 274). Held places it in his climax vegetation zones 5+8, “Interface of Western Upland Forest of Aleppo Pine, Hermes Oak, and Wild Olive; and Maquis of Carob and Lentisk, replaced below 350 m asl. by Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy” (Held 1992, 150). It falls in a precipitation zone receiving 400-500 mm of rainfall a year, and soils are characterized by Held as the “Interface of Xerorendzinas on limestones, chinks, Pliocene marls, and very calcareous deposits; Alluvial Soils, and Silicate Raw Soils on Mamonia rocks” (Held 1992, 150). Held also notes that the site lies at the geological interface of the Pakhna and Moni formations (Held 1992, 150)

Simmons has suggested that the original vegetation regime around the site would have consisted of pine (*P. brutia*) on the pillow lavas, Cypress on the sedimentary limestone, with oak (*Q. lustitanica*) perhaps predominating, while shrub

vegetation included scrub oaks, terebinth, wild olive and oleander (Simmons 1994, 3). This reconstruction seems to be based largely on observed vegetation in the vicinity of the site. If it is approximately correct, it represents a very different micro-environment from that at the lowland sites of Shillourokambos and Mylouthkia.

14C dates obtained range from 6385-5420 cal BC (Simmons 2003, 63; Simmons 1994), placing it in McCartney and Todd's (2005, 177) Late Cypriot Aceramic or Khirokitean, roughly contemporary with Cap Andreas-*Kastros*, Khirokitia-*Vouni*, and Kataliondas-*Kourvellos* (all discussed below). The size of the site has been estimated at 2.4 ha (Fox 1987, 22; Simmons 1994, 2), smaller than either Kataliondas or Khirokitia.

Excavations have produced little evidence of surviving architecture, perhaps due to post-Neolithic plowing and cultivation, but a layer of hard-packed clay extending over much of the excavated area of the site might represent an original surface (Simmons 2003, 63). Soils on the site may have been less than ideal for the construction of Khirokitean style stone and mudbrick houses: when wet, they were prone to expand and contract dramatically and rather than draining would have been viscous in character, a kind of “gunk” (Simmons 2003, 64). There is some evidence for mud brick and presence of pits (Simmons 2003, 64). As at Ais Yiorkis, the site yielded very extensive chipped and ground stone assemblages representing all stages of lithic reduction (Simmons 2003, Simmons 1994).

While flotation was conducted, paleoenvironmental data are as scanty as at other Aceramic sites. Plant species recovered include einkorn and emmer wheat,

barley, pea, lentils, and the seeds of weeds often associated with cultigens (Simmons 2003, 65). These were not recovered in sufficient numbers to permit any estimation of their relative importance. The animal remains from the site are similar to the latest phases at Khirokitia (discussed below), with a high proportion of sheep and goat and relatively few fallow deer (see Table 2, below).

Croft has argued (2003, 276), with regard to the faunal assemblage at Ortos, that running mixed flocks of sheep and goats was probably a strategy to take full advantage of available browse, since goats will eat things sheep will not. Epiphysal fusion data reflect a pattern in which significantly more males than females were culled before 10 months, consistent with production for meat (unless the smaller cluster of larger animals in Croft's Fig. 1 represents larger wild caprines).

Measurements of distal radii of deer from Ortos also suggest deliberate culling of young males, as at Tenta and Dhali-*Agridhi*, discussed below, while the underrepresentation of deer phalanges suggests butchery in the field (Carter 1989; Croft 1989; Croft 2003, 275).

Human remains were recovered mixed with other artifacts (Simmons 1994, 10), though is more likely a mixed secondary deposit than the deliberate deposition seen at Shillourokambos and Mylouthkia. The remains consist of mandibles and teeth representing at least two individuals. One was in very poor overall dental health, with periodontal disease: specifically, a torus mandibularis, abscess of an incisor and resorption of six alveoli (Simmons 1994, 10-11). His or her condition was not only painful, but potentially dangerous. However, these pathologies permit few specific

inferences about the diet of this individual, let alone the community.

Simmons, while he envisions Ortos as a “permanent settlement,” argues that it represents a herding, rather than an agricultural, strategy (2003, 65). There is, however, little evidence for the relative importance of the herding and cereal crop sectors of the village economy; it seems likely that all households would have participated in both to some degree, here and at other Aceramic sites. Paul Halstead's 1987 paper on the range of variation in premodern mixed agro-pastoral strategies is particularly relevant here.

KANNAVIOU KOCHINA and KEDARES-YERO VASILI

The site of Kannaviou-*Kochina* (Stanley Price 1979, Fox in Rupp et al. 1984, Fox 1987, Peltenburg 1982, Swiny 1985, Held 1992, 149), is located quite close to Ais Yiorkis, hard by a rocky promontory (Fox 1987). It is also at altitude (345 m ASL) and falls in a zone of precipitation typically receiving 600-700 mm of rainfall a year, in a region characterized by upland forest of Aleppo pine, Kermes Oak, and wild olive (Held 1992, 149). During survey by the CPSP its size was estimated at 1.4 ha (Fox 1987, 22). It was tested by Simmons' team (Simmons 1998a, 1998b, 2003), but the limited scale of the excavation does not justify any conclusions about the degree of resource stress at the site.

Kedares-*Yero Vasili*, in the upper Dhiarizos river valley, was also identified during survey (Rupp 1987; Fox 1987, 24). Its size was estimated at 0.1 ha (Fox 1987, 24). It lies at approximately 390 meters asl (Held 1992, 151). Held locates it in climax

vegetation zones 4+5: “Interface of Upland Forest of Aleppo Pine, Hermes Oak, and Wild Olive, and Western Upland Forest of Cyprian Oak and Hermes Oak on limestone and Mamonia Complex,” and in soil zones indicating “Interface of Brown Earths; and Calcareous Raw Soils” (Held 1992, 151). Geologically, it lies at the interface of Pakhna and Lefkara formations, in a zone which in the 20th century has generally received almost 600-700 mm of rainfall annually (Held 1992, 151), one of the highest ranges for any identified Early Prehistoric site.

While little is known about either of these sites, both are important in indicating the presence of other aceramic sites in the vicinity of Ortos and Ais Yiorkis. Counting these two sites, then, it appears there was at least one aceramic site in the three major river valleys investigated by the CPSP. These are, north to south: Ais Yiorkis and Kochina in the Potamos Ezousas valley, Ortos about 20 km SW in the Xero Potamos valley, closest to the coast of any of these sites, and Yero Vasili in the Dhiarizos valley, about 20 km NE of Ortos and slightly more than 20 km SE of Ais Yiorkis and Kochina (see map, Fig. 5).

DHALI-AGRIDHI AND SITE E

Turning now to those aceramic sites east of the Troodos massif, it seems reasonable to continue with two more inland sites which seem to occupy zones of geological and environmental transition: *Dhali-Agridhi* and *Kataliondas-Kourvellos*. Both date to the later aceramic Neolithic, but are located in close proximity to what now appears to have been a Cypro-PPNA “home area” along the Yialias drainage and

the boundary of the pillow lavas (McCartney et al. 2005).

Dhali Agridhi was initially identified by Dikaios (Dikaios and Stewart 1962) and was excavated by the American Expedition to Idalion in the 1970's. As Todd remarks (1987, 180) its location is somewhat unlike that of other Aceramic sites, in being on the southern bank of the Yialias rather than on a hill or rise, and unassociated with any prominent natural landmark like Kourvellos or the rocky knob of Cap Andreas. Held has located it in vegetation zones 4+10+11, "Interface of Upland Forest of Aleppo Pine, Hermes Oak, and Wild Olive in Troodos Piedmont zone; Mesaoria Maquis of unknown composition, with greenbelt of hydrophile plant community along Yialias River, and Hypothetical Larnaca Forest," in a precipitation zone receiving 300-400 mm of rain per year, and in his geological zones 6+10: "Interface of deep Xerorendzinas on limestones, chalks, Pliocene marls, and very deep calcareous deposits, and Alluvial Soils" (Held 1992, 78). Vegetables are grown with the aid of irrigation and cereals dry farmed near the site (Held 1992, 78).

The site has both Aceramic and Pottery Neolithic components. The spatial extent of the Aceramic site is uncertain, but it was probably small, under 1 ha. The excavated aceramic component consists of a lithic workshop, midden, and pits (Lehavy 1989, 205). This occupation or use appears to have been roughly contemporary with Khirokitia, approximately 15 kilometers to the south, on the basis of the three published radiocarbon dates from the Aceramic levels: 5340 +/- 465 cal BC (GX 2848A); 5450/5680 +/-60 cal BC (P-2768); and 6040/6280 +/-80 cal BC (P-2775) (Lehavy 1989, 216, Table 6).

Though all excavated soil was floated, only a limited number of seeds were recovered. These have been identified as wild lentils (*Lens orientalis*, identification as wild based on size), wild einkorn wheat, (*Triticum boeoticum*) and wild pistachio (*Pistacia atlantica*) (Lehavy 1989, 206). Wild pistachio or lentisk is still economically important in some areas of Western Asia, including Iran, not only for its fruit, smaller than those of the domesticated pistachio, but for a resin which has many uses including food and traditional medicines (Pourezza et al. 2008). Stewart also identified wild grape and vetch (1974, 124), the former a food source and the second a likely source of animal fodder, as well as a “starvation” food for humans.

The faunal material recovered from the site has been studied by both Paul Croft and Patrick Carter. Croft's (1989) re-analysis of bones from the 1972 season tallies closely with the figures obtained by Carter (1989) and by J.H. Schwartz (1974). While element data have been published for the fauna from the 1976 excavations, a commendable step, these are not separated by physical context or period, precluding any assessment of change in herding practice over time. Species representation is reported in Table 2, at the end of Chapter 6.

Of the bones recovered in the 1976 excavation, between 70% and 80% belonged to fallow deer. Of these, nearly 85% of long bones with surviving epiphyses exhibited evidence for epiphysal fusion (Carter 1989, 248, Table 6). While we lack detailed studies of the age at which fusion occurs in modern *Dama mesopotamica*, it seems safe to assume that this figure reflects a high proportion of adult animals and a low proportion of juveniles (Carter 1989, 248). Croft obtained figures of 74% fused

and 26% unfused, which he interpreted to reflect a mortality pattern in which almost 40% of animals in the sample died before ca. 4 years old. Assuming this number is not an artifact of differential deposition or preservation, it indicates the preferential selection of young adult animals alongside more modest numbers of subadults, juveniles, and infants. Croft's sample exhibits bimodal clustering in distal humerus measurements, which he very reasonably takes to indicate sexual dimorphism. The two sexes are approximately equally represented, though females may have been allowed to live longer in order to produce more offspring (Croft 1989, 265). This mortality pattern is in contrast to that observed at Shillourokambos, where a relatively high proportion of juveniles has been taken to indicate hunting of whole herds (Vigne et al. 2003). Croft argues that Dhali *Agridhi* enjoyed “an abundance of available deer meat—Neolithic affluence, epitomized by an “expensive” dietary preference for young venison” (Croft 1989, 265).

Carter has posited a decrease in average size in fallow deer from Pleistocene and early Holocene sites at Tabun, El Wad, and Ain Mallaha in the Levant and Neolithic Dhali-*Agridhi*, and from the Neolithic to the Late Bronze Age (Carter 1989, cf. Halstead 1977). As Croft points out, however, this is necessarily based on very small sample sizes; combining Croft's sample with Carter's, the mean proximal radius widths are actually greater than those at Ain Mallaha (Croft 1989, 267-270). It would appear to be unwise to read too much into size ranges at Neolithic sites with small faunal samples.

Among the ovicaprids, Carter identifies several size classes, which he argues

correspond with *Ovis aries*, *Ovis orientalis*, and *Capra hircus*, while Croft found no basis for identifying species in his sample, and argued the size range could be accounted for by sexual dimorphism (Carter 1989, 246; Croft 1989, 264). Both found that where bones could be assigned to sheep or goat, they more often belonged to sheep (Croft 1989, 264). Most animals were slaughtered at from 2-3.5 years of age, in keeping with a strategy that prioritized female reproduction and meat production (Croft 1989, 264).

Pig is the least well represented of the ungulates at Dhali *Agridhi*. Carter argues their average size does not mark them as either wild or domestic, and suggests with some justification that these terms may be out of place in a society such as that of Dhali *Agridhi*, so clearly dependent on both hunting and husbandry (1989, 247). The relatively small contribution to diet made by pig as against ovicaprines is consistent with the latest phase (II and I) at Khirokitia, though pigs had been important at earlier phases at Khirokitia and at other sites like Tenta (Croft 2005). The perforated tusk of a wild boar was recovered from the site; suggested uses include a pendant or needle (Lehavy 1989, 209), though it surely would have made a very thick and unwieldy needle. If worn as a pendant, the tusk of what was at the time quite possibly the most dangerous animal on Cyprus might reflect some degree of status attaching to the successful hunter.

Little support can be found in either Croft's or Carter's elemental data for differential transport of any of the three ungulate species exploited at Dhali *Agridhi*. However, cranial elements accounted for a very low percentage of NISP among pigs

(2.7%), a higher percentage for caprines (17%), and a very high percentage (excluding antlers) for fallow deer (30%) (Croft 1989, Tables 3, 4, 5). Along with the high number of deer antlers found on site—most of which are believed to have been unshed and therefore obtained from the skulls of dead animals—this figure suggests that these hunted animals were regularly brought back to the site with their heads still attached. If Croft is correct that the mature deer were disproportionately males, it hints at the desirability of antlers, for prestige or utility. It is possible that the process of separating the antlers from deer skulls resulted in a higher number of fragments of deer crania than of pig or ovicaprid skulls; bone weights are not available for comparison.

The admiration of impressive antlers is not a uniquely modern phenomenon. If prehistoric Cypriots had a special appreciation for big bucks with impressive racks of antlers, as depicted in later coroplastic and painted ceramic representations (Flourentzos 2002), this might have been an added incentive to cull adult males, contributing to the long-term viability of the hunted population as a whole (see Chapman and Chapman (1975) on the herd structure of fallow deer under different environmental conditions). The excavators have remarked on the number of long splinters of (mostly deer) bone in the faunal assemblage (Lehavy 1989, 209). Crushing bone for marrow extraction does not generally produce such a pattern; rather, the bone splinters may have been produced accidentally, or perhaps deliberately, for manufacture into needles or pins.

Again, despite the quantity of soil subjected to flotation, few small animal remains were recovered. These included one each of tortoise, cat or fox, crab, and bird

from Aceramic contexts, and a fish vertebra and fox femur from contexts which could not be assigned with confidence to either the Aceramic or Late Neolithic (Croft 1989, 270, note 4). This range of species is familiar from some other Aceramic contexts: Shillourokambos, for example. Aquatic resources including crabs had also been exploited at the Cypro-PPNA site of Ayia Varvara *Asprokremos* (McCartney et al. 2007), some 6 km from Dhali-*Agridhi* and likewise situated on the south bank of the Yialias river, in an area which today hosts a considerable population of birds, frogs, turtles, and snakes.

Site E—not to be confused with Site E on the Akrotiri peninsula—is located some 200 m SW of Dhali- *Agridhi* proper (Lehavy 1989). A floor of cobbles and ground stone artifacts capped a dump of debris including faunal material, broken stone bowls, and chipped stone. All these classes of material appear to have been included with those from Dhali-*Agridhi* for purposes of analysis.

The cobbles which made up the floor were heterogenous in their geological condition and some probably brought from a distance; the chipped stone likewise probably comes from many sources (Stewart 2004). Sarah Stewart, Margaret Morden and the Elaborating Early Neolithic Cyprus project have identified numerous chert sources and lithic scatters from Dhali west and north along the juncture of the pillow lavas and limestone sedimentary zone (see McCartney et al. 2007). Evidence for possible long-distance contacts at Dhali-*Agridhi* comes in the form of obsidian sourced by neutron activation to Anatolia (Lehavy 1989, 207). The role of such contacts in mitigating possible subsistence risk is discussed below.

There is insufficient evidence at either Dhali *Agridhi* or Site E for intensification of food production over time, local environmental change, change in the nature or volume of storage, or change in the nature and number of pathologies affecting people. The Sydney Cyprus Survey Project and Elaborating Early Neolithic Cyprus project have revealed that the site did not exist in isolation; the nearest known likely candidate for a permanent settlement is at Kataliondas- *Kourvellos*, some 12 km to the west.

KATALIONDAS-KOURVELLOS

Kataliondas-*Kourvellos* is located below a conspicuous rocky outcrop in the foothills of the Troodos mountain range, near the (now defunct) village of Kataliondas (Watkins and Morrison 1974; Watkins 1979; Watkins 1980, Watkins 1983). Intensive survey of the site by Watkins resulted in a large collection of chipped and ground stone. Based on typological parallels for chipped and ground stone artifacts, including sophisticated vessels in hard stone similar to those at Khirokitia and Cap Andreas, the site is generally assigned to the later Aceramic Neolithic (McCartney and Todd 2005). Additionally, artifacts identified as mace heads (Watkins and Morrison 1974, 70) were identified in the south sector, the plowed fields immediately to the south of the rocky knob *Kourvellos*.

The area of the artifact scatter is estimated at > 15 ha, but artifact density is uneven and the site has not been excavated beyond minimal testing. Watkins and Morrison found no evidence for any built structures and believed there were none to

be found (1974, 73). Because the site was never excavated, data for the subsistence economy and local paleoenvironmental conditions are lacking. However, the sheer quantity of ground stone suggests that these tools were destined for use by people dependent on cereals, whether or not they were resident at the site year-round.

Kataliondas lies in the zone of transition from the pillow lavas to limestone sedimentary zone the importance of which has already been alluded to. Whether it represents a special-purpose site or a “village without walls,” to borrow Alan Simmons's phrase (2003), it is important, along with Dhali-*Agridhi* and Ortos, in showing that the later Aceramic was not confined to coastal villages.

RIZOKARPAZO-CAP ANDREAS KASTROS

Cap Andreas is situated on the very tip of the Karpass peninsula, right on the modern coast (map, Fig. 5). It was a small village of round structures; its surviving extent is 0.17 ha and it is difficult to estimate its original extent, but it may have been as much as 1 ha. Held situates it in his vegetation zone 9, “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper, with or without Carob and Wild Olive under localized Aleppo Pine canopy”; the present-day geology is kafkalla bedrock (Held 1992, 90).

There are three radiocarbon dates for the site, two from Level V and one from Level VI (Le Brun 1981, 71). These are 6140 B.P. +/- 200 (MC 803), 7450 B.P. +/- 120 (MC 807), and 7775 B.P. +/- 125 (MC 805) respectively (Le Brun 1981, 71). They were obtained using a half-life for ^{14}C of 5570 years, but it is unclear what

calibration curve if any was used. Le Brun rejects the high date as too late for the aceramic, and cannot resolve the other two with the stratigraphy of the site (1981, 71). However, it is generally considered to belong to the late Aceramic Neolithic or Khirokitean (McCartney and Todd 2005).

With regard to the local environment, Le Brun has noted the heavy, iron-rich soil and the maquis vegetation in the immediate vicinity of Cap Andreas (1981, 11) today, but follows the suggestion of Jones et al. (1958, 24) that in the Neolithic the island would have been covered in evergreen sclerophyllous forest, with different tree species (oak, juniper, cypress) dominant in different regions. In the absence of any pollen or anthracological data, we are forced to fall back on the evidence of the botanical remains. From these it is impossible to assess the relative importance of pine, oak, pistachio, and wild olive, since only remains of the latter two have been recovered. Meadow and waste-ground plants like mallow (*Malva*), burclover (*Medicago*), wild grasses (*Phalaris*), and plants like Chenopodiaceae, vetch (*Vicia*), and ryegrass (*Lolium perenne*) which frequently accompany cereals, may be overrepresented if they were accidentally collected when cereals were harvested, or deliberately harvested themselves as food for farmers or animal fodder (cf. Halstead and Jones 1989). However, they are more suggestive of open fields, meadows, and waste ground than of pine forest extending to the edge of the sea. The marine molluscs are not diagnostic from a climatological point of view (Cataliotti-Valdina 1994, 363).

Botanical remains recovered in the excavation include the normal suite of cereal crops and pulses: both einkorn and emmer wheat, hulled barley (*Hordeum*

vulgare), lentil, and pea (*Pisum sativum*), though the identification of the last is not entirely secure: it might be vetch (van Zeist 1981, 95, 97). *Triticum monococcum* and *Triticum dicoccum* occur at a ratio of slightly less than 1:2. The small sample size should not inspire undue confidence in this ratio, but if it does reflect the proportions in which these were grown, it might, as van Zeist argues, represent either a “founder effect,” i.e., farmers from an area where einkorn was more common, such as perhaps its home region in the mountains of Southeastern Turkey, though its range may have extended much further south before the Younger Dryas cold interval (Nesbitt 2001, 48; Hillman 1996), or a local adaptation (van Zeist 1981, 97). *Triticum durum/aestivum* (hard or bread wheat), common during the Neolithic in southwest Asia, was not identified (van Zeist 1981, 97).

Van Zeist suggests that barley was less important than wheat, presumably because almost twelve times as many wheat grains and spikelets were recovered as barley (Van Zeist 1981, 97 and Table 1). If the two were not grown together as maslin (Hansen 2005; cf. Halstead and Jones 1989) but as monocrops, they may have been processed differently, eaten in different forms, and subject to different processes of deposition.

Carbonized seeds also included ryegrass (*Lolium perenne*), which at this stage was probably a weed growing alongside wheat (Hillman 1978) but which might have been eaten, *Malva*, possibly *Malva silvestris* (common mallow), vetch (*Vicia* sp.) and flax or linseed (Van Zeist 1981, 99). Since it was impossible to determine whether seeds of *Chenopodium* were carbonized or not, all were treated as modern and

intrusive (Van Zeist 1981, 97). Another frequent accompaniment to cereal crops, the seeds of Chenopodiaceae are edible and were used extensively in North America (Smith 1992). Finally, carbonized remains of edible wild plants included pistachio (*P. atlantica* or *P. terebinthus*), fig, and wild olive (Van Zeist 1981, 98).

Both the excavator and the botanical specialist argued against any meaningful change in the botanicals over the course of the site's occupation (Van Zeist 1981, 95). There is no apparent increase in *Triticum dicoccum* relative to *T. monococcum* (Van Zeist 1981, Table 1). Again, the small size of the sample (168 identified examples of *T. dicoccum* in all) should be stressed. No pollen analysis was able to be undertaken, and charcoal samples from flotation were not identified as to species.

Faunal data for Cap Andreas reflect an animal economy broadly similar to those of other aceramic Neolithic sites, albeit with some important differences (Ducos 1981; Davis 1989). Fallow deer make up about 40% of the total faunal assemblage at Cap Andreas by NISP, but their importance changed dramatically over time. In Level II (the earliest from which bones were recovered) they were only 19% NISP, but they increased over time to 47% in Level VI (Davis 1989, Table 4b). The number of juvenile fallow deer is lower than either pigs or caprines, probably reflecting a herd management strategy that encouraged allowing young (and especially young female) deer to attain reproductive age (Davis 1989, 205).

Pig increased from 18% NISP to 46% NISP in Period IV, then decreased to 30% in Level V and increased slightly to 35% in Level VI. However, because there are so many piglets represented, NISP probably does not reflect contribution to diet in

terms of number of calories. 22% of pig scapulae, 54% metapodial bones, 76% Calcanea, 33% anterior mandibles are osteologically juvenile (Davis 1989, 206). The last figure represents only a single anterior mandible. Both overall size and dental data are consistent with all the pigs being domestic, if a “large, primitive breed” (Davis 1989, 197, 207). There is no evidence for members of a wild or feral (presumably hunted) population existing alongside domestic stock, as was apparently the case at Shillourokambos (Vigne et al. 2009).

Sheep and goat exhibit a marked decrease over time as a percentage of the total faunal assemblage, from 62% in Level II and 45% in Level III to an eventual 19% in Level VI (Davis 1989, Table 4b). Goats outnumber sheep by ratios of 5:1 in metacarpals ; 4:0 in astragali ; 2: 2 in metatarsals, the reverse of the pattern at Khirokitia and Tenta (Davis 1989, 195-196 and Tables 5e, 5f, 5g). Davis has suggested that goats were better adapted to the rocky terrain of the eastern Karpass (1989, 206); but sheep thrive elsewhere on rocky terrain. Le Brun has noted the absence of evidence in the lithic assemblage for hunting (Le Brun 1981, 74), referring presumably to the absence of points. Projectile weapon technology is not always easily identifiable in the archaeological record, due to the use of expedient points (Wendorf 1968; Shea 2006). Statements like these highlight the danger of making inferences about economic practice from single lines of evidence.

Fish and marine invertebrates at Cap Andreas (Garnier 1981, Desse and Desse-Berset 1989, 1994, 2003) represented “un ressource alimentaire non négligable et d'autant plus appréciable qu'elle était constant” (Le Brun 1981, 74). Nearly 6000 fish

bones were recovered, of which about 2500 were identified to species level (Desse and Desse-Berset 1994, 337). *Euthynnus*, *Thynnus*, and other Scombridae (tunnies) and *Epinephelus* (groupers) predominate, accounting for about 37% and 29% of the identified bones respectively (Desse and Desse-Berset 1994, 338). The little tunny, however, is vastly underrepresented by cranial fragments and both thoracic and post-caudal vertebrae, suggesting that heads and tail fins of this species were removed off site (Desse and Desse-Berset 1994, 342 and Figure 3). Presumably cleaning was best done off-site since the offal quickly become odorous and attract the attention of scavengers. Fish heads are a low utility part of the animal in terms of calories, but meat from the heads is often eaten with relish, not least in the famous fish restaurants of Zygi on the south coast of Cyprus, not far from Kalavassos.

Members of the group Sparidae (breams) accounted for a further 22% of the identified fish remains and are eminently edible (*Sparus aurata*, the gilt-head bream or *tsipoura*, is a fixture of fish restaurant menus in Cyprus). The remains belong to all sizes and age classes, suggesting no selection for large or mature fish (Desse and Desse-Berset 1994, Fig 5 and 6). Unlike the tunnies, these fish were apparently brought on site with heads and tails still attached: thoracic and caudal vertebrae are much more evenly represented (Desse and Desse-Berset 1994, 351). A contemporary case of the differential processing of large and small fish, with the latter possibly being processed for storage, is known from the submerged PPNC “Mediterranean fishing village” of Atlit-Yam on the coast of Israel, ca. 8000-7550 cal BP (Zohar and Dayan 2001).

Triggerfish (*Balistes carolinensis*) account for about 7% of identifiable fish remains (Desse and Desse-Berset 1994, 353). This species likes warm coastal waters; all sizes are represented, including two individuals of probably more than 2 kilos live weight (Desse and Desse-Berset 1994, 354). *Serioli dumerili* (amberjack) is today a popular game fish: like the tuna, it is a fast swimmer and preys on other fish in deep water; it easily attains a meter in length and 10 kilos weight or more (Desse and Desse Berset 1994, 347). A single wrasse (*Labrus* sp.) shows that at least some smaller fish were taken, preserved archaeologically, and recovered in excavation.

Desse and Desse-Berset suggest that larger and smaller fish were probably caught together, “lors des mêmes opérations de pêche” in the the rocky zone inshore (1994, 340). Others, like the tunnies and amberjack, are seasonal migrants and typically frequent deep water in search of prey (Falautano et al. 2007): they might therefore conceivably represent pelagic fishing (Desse and Desse Berset 1994, 340). Numerous fishhooks are attested on site, and some of the perforated stones and “necked” pebbles recovered in the excavations may have been line or net weights (Le Brun 1981, 74; Desse and Desse-Berset 1994, 357); any floats made from skin or animal bladders have of course not survived.

Not only bony fish but marine invertebrates were well represented at Cap Andreas (for a complete list of species see Cataliotti-Valdina 1994). Three varieties, *Monodonta* (top shells), *Patella* (limpets), and *Columbellae* (dove snails) accounted for nearly 75% of the shell on site (Cataliotti-Valdina 1994, 362). *Conex*, *Luria*, *Hexaplex* (= *Murex trunculus*), and *Pisania*, all marine molluscs, account for from 2-

6% of the shell (Cataliotti-Valdina 1994, 362). Otherwise, there is minimal evidence for exploitation of small game. The mice from the site were not able to be identified precisely, but are probably a variety of house mouse (Helmer 1981; Davis 1989, 191). Bird remains were not reported at Cap Andreas—unlike Mylouthkia and Aetokremnos, where, in the Epipaleolithic, white-front geese apparently made a major contribution to diet (Simmons 1999).

Desse and Desse-Berset's comprehensive study has thus far failed to identify any change in fishing practice over time; some apparent diachronic variation really corresponds with different kinds of spaces on the site (1994, 337). However, the number of fish remains is notably higher in Levels V and VI; these are due in large part to high numbers of *Epinephalus* and *Euthynnus* (Davis 1994, Table 1). The highest numerical value for fragments of marine invertebrates, on the other hand, occurs in Level IV, which also had the highest number for MNI: the shell from this level was not simply more fragmentary, leading to a higher count (Cataliotti-Valdina 1994, Table 1). *Patellae* were most important, *Monodonta* next, then *Murex* or *Hexaplex* and several kinds of bivalves (Cataliotti-Valdina 1994, 366). This same level, Level IV, contained the lowest absolute number of caprine bones of any at the site, the second lowest of fallow deer, and a much higher number of pig bones: pig was the dominant faunal taxon for this period (Davis 1989, Table 4b). While the spatial context of Level IV is highly restricted (Le Brun 1989, 1994), prey selection is at least suggestive of a spike in the exploitation of marine resources, of which shellfish were more than ordinarily important.

As at most other Aceramic Neolithic sites, it is difficult to determine whether pits on the site were used to store grain, and no other specialized storage facilities were identified. Nor is the dead population highly informative in terms of subsistence risk and its consequences. There are three burials containing four individuals: three adults and an infant, all extra-mural interments (Le Brun 1981). Shells and shell fragments were recovered in all three burials, and in one, two pearls were found, but there were no other grave goods (Le Brun 1981, 28). The deposition of marine shell in burials at Cap Andreas is an unusual feature both in the Cypriot Aceramic Neolithic (Niklassen 1991) and in the greater PPNB “interaction sphere” (Kujit 2001; Kujit 2004).

While as a dot on a map it appears terribly isolated, at the end of the Karpass peninsula, Cap Andreas was not entirely alone. Survey in the vicinity of Rizokarpazo identified chipped stone and ground stone compatible with additional Neolithic activity and settlement in the area (Held 1992, 90-94). Additionally, there is a large body of circumstantial evidence for long-distance contacts between people at Cap Andreas and groups on the mainland. This includes the position of the site at the eastern extremity of Cyprus, the existence of specialized “Mediterranean fishing villages” on the Levantine coast (Galili et al. 2002), the presence at Cap Andreas of obsidian originating in Anatolia, and the practice of cranial deformation, also found among mainland groups (Massei Solivères 1981). I have argued above in Chapter 2 that among foragers, long-distance contact is often used to help buffer against resource shortages; that this is obviously made easier by far-flung kinship networks and fluid

band composition but is also true in some cases of relatively sedentary groups, whose patterns of mobility and resource storage were not so unlike early agricultural village societies.

The amount of raw material exchanged was not, insofar as we can determine, highly significant. The entire obsidian fraction of the chipped stone assemblage consists of nine blades and bladelets more or less even distributed over Levels 2 through 6, with three from the surface and one from an unknown context (Le Brun 1981, 40). Analysis by Colin Renfrew indicates the obsidian originated in central Anatolia (Le Brun 1981, 41), though of course it may have come to Cyprus as a result of “down the line” exchange. It seems likely therefore that exchange of obsidian was a byproduct, rather than a cause, of whatever contacts existed between people at Cap Andreas and those in the rest of southwest Asia.

In many respects social practices at Cap Andreas appear to have differed from those on the mainland. As noted above, shells were interred with the dead and apparently worn as ornaments; though there is no evidence for a shell bead industry such as has been proposed for Aetokremnos (Simmons 1999). As Kujit has pointed out, the provision of the dead with shell bead necklaces seems to have been a feature of the first part of the Late Natufian period in the southern Levant, and to have ended around 13,000 BP; it was not a common feature of contemporary PPNB practice on the mainland (Kujit 2001, 87). The structures at Cap Andreas were all round, rather than the rectilinear dwellings favored by many (but not all) mainland PPN communities (cf. Flannery 1972). Such variations in architecture and symbolic

behavior should not, however, be taken to preclude the existence of kinship or affinal ties between communities on Cyprus and groups in south-eastern Anatolia or the Levant.

To sum up, the small Aceramic village of Cap Andreas exhibits a range of breadth in its use of domestic and wild plant resources similar to other contemporary sites, but a greater breadth in the faunal component of the assemblage than any other Aceramic site on Cyprus, relying on domestic animals, terrestrial game, and marine resources. Fishing was clearly a real component of the subsistence strategy. The villagers took advantage of predictable seasonal migrations of large predatory fish like tunnies (cf. Falautano et al. 2007) representing a temporal and spatial concentration of a high-ranked resource. These fish may have been able to be preserved, and stocks of dried or salt fish would have been a considerable aid in dealing with short-term shortages (Desse and Desse-Berset 1994, 357). Other kinds of fish, like merou, were caught at all different times of year, to judge from the range of sizes represented (Desse and Desse-Berset 1994, 357), and a broad range of marine species other than fish are attested: marine invertebrates, crabs, and sea urchins (Desse and Desse-Berset 1994, 357; Cataliotti-Valdina 1994). Whether this range reflects opportunistic collection strategies or responses to short-term resource stresses is difficult to assess.

KALAVASOS TENTA

The site of Kalavasos *Tenta* is a walled village of circular stone and mudbrick structures on top of a small rise in the floodplain of the Vasilikos river. It was recorded

during the Cyprus Survey and excavated during the Vasilikos Valley Project (VVP), a regional study of the Vasilikos valley catchment which located and excavated important sites of several prehistoric periods (Todd 1987, with full bibliography p. 191; Todd 2004, Todd 2005). During survey the site size was estimated at about 0.26 ha (Gomez et al. 1987, 11). The relatively large exposure and careful nature of the excavations provide a great deal of information about changes in economic behavior over time. The survey component of the VVP also located a small number of other Aceramic Neolithic sites which help to provide a spatial context for Tenta. Held places the site, along with most others in the Vasilikos valley, in vegetation zone 8: “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy” (Held 1992, 97), receiving about 400-500 mm of rainfall a year, and characterized by surface geology including “Interface of Calcareous Raw Soils, deep Xerorendzinas on limestones, chalks, Pliocene marls, and very deep calcareous deposits, and Alluvial Soils” (Held 1992, 98).

Site catchment analysis by J. Malcolm Wagstaff (2005) suggests that Tenta itself is not ideally placed with regard to easily cultivatable land, though in a semiarid region there are certainly worse places to grow cereal crops than deep river alluvium adjacent to a water source. The Vasilikos may have flowed year-round in wetter periods of prehistory (Gomez et al. 1987, 12; Robinson et al. 2006). The botanical assemblage contains seeds from plants such as canary grass (*Phalaris*) and black bog rush, which are likely to have grown in the riparian zone adjacent to the river. Skeletal

morphological indications of thalassemia or sickle cell anemia may reflect an environment that bred mosquitoes, the vector for malaria (Moyer 2005, 3; Angel 1966; Angel 1972). Even today the mosquito population of Kalavassos village is fairly aggressive.

Evidence for maquis-type vegetation probably derives from the slopes of the valley and upland areas (Hansen 2005, 324). Some evidence exists to suggest the neighborhood of the site was relatively open: *Lithospermum arvense* or Gromwell is presently widely distributed across Asia and found on hillsides and margins of cultivated land. Unfortunately, there are no anthracological or pollen data for Tenta to compare with the paleobotanical sample, and against which to assess the changes in the faunal assemblage.

Despite poor preservation, which is the norm on prehistoric sites in Cyprus, flotation (7764 liters) recovered plant remains from all periods. These have been analyzed by Julie Hansen (2005), whose excellent discussion pays careful attention both to their temporal and their spatial distribution. Thus, she is able to point out that emmer wheat, lentils and barley were all present from Period 4/5 (as indeed we would expect from Shillourokambos), and that einkorn wheat and a small-grained possibly wild barley joined them in Period 4 (Hansen 2005, 326). Likewise, she draws attention to the preservation of most seeds in hearths or firepits and pits, both mostly outside structures, though seeds never occur in the latter type of context in sufficient numbers to warrant the identification of the pits as storage facilities (Hansen 2005, 325-6).

A roughly equal number of grains of einkorn and emmer wheat were recovered overall, with einkorn apparently giving way to emmer over time—but as Hansen

cautions, this is based on a very small sample, 130 identified grains of both kinds of wheat altogether (2005, 326-7). Additionally, quantitative comparison of the numbers of different plant remains recovered is always difficult, since they are not the result of a random sample, but rather potentially subject to differential transport, processing, storage and cooking. Variation in these practices can produce very different representations not only of cereal crops but of weeds and wild plant foods (Dennell 1976; Halstead and Jones 1989).

Based on the observation that domesticated barley was nearly always found along with both species of wheat, Hansen has suggested the possibility that the crops were sown together, grew intermixed as maslin, and were reaped and processed together (2005, 327). Use of maslins was once common practice in Greece and elsewhere in Europe, as it provided at least a partial hedge against variation in growing conditions (Halstead and Jones 1989, Jones and Halstead 1995). There might have been other factors favoring polycropping in the Early Prehistoric. First, there is the labor involved in separating wheat and barley in a maslin harvest so as to obtain separate stores of wheat and barley seeds for sowing as monocrops (see the quote from Halstead and Jones below). Second, traditional Mediterranean agricultural practices often rely to a greater or lesser degree on cattle for plowing and donkeys for threshing and transporting harvested cereals. In the Neolithic, the lack of harnessed animal power may have contributed to the spatial concentration of cereals, making them more vulnerable to localized drought or unseasonable rain. With the risk of spatial concentration built in, farmers may have relied even more heavily than observed

“traditional” agricultural societies on polycropping to provide at least a partial harvest in inevitable bad years.

Legumes were important not only as a more significant contributor to diet than in recent times, especially since they furnish protein, but potentially in crop rotation, as a nitrogen-fixing plant. In traditional agricultural regimes in the Mediterranean, vetches of all sorts are important as winter fodder for livestock, while some species such as broad bean (*V. faba*) are also a regular feature of human diet (Halstead and Jones 1989). They too are nitrogen-fixers. *Medicago*, a genus which encompasses burclover and alfalfa, was also present at Neolithic Tenta (Hansen 2005, 341). Grown today primarily as fodder, it may also have been eaten by prehistoric people. Work by Paul Halstead and Glynnis Jones makes it clear the extent to which the use of such crops is both a product of both tested communal practice and individual strategy:

The sowing of wheat/barley and common vetch/grass pea(/pea) maslins on Amorgos... was quite explicitly perceived as a way of 'hedging bets'. Wheat and barley made up widely varying proportions of 'migadhi' seed corn, depending on the quality of the field and the availability of seed, but their relative contribution to the harvest also depended on the growing conditions in a given year. Plentiful rain during the growing season tended to favour the more highly valued wheat. The pulse maslin represents a compromise between the preference of livestock for grass pea and the greater productivity and resistance to infestation in the field by *Bruchuss* pp. of common vetch. The great flexibility of the wheat/ barley maslin becomes even more apparent during processing. In good years, the crop tended to be both abundant and relatively rich in wheat and the grain was separated with a special (4-5 mm mesh) sieve into wheat- and barley-rich fractions, the former being used for bread or sold for cash, the latter for fodder. In bad years, bread would be made largely from barley and the livestock would not be fed grain. In the recent past in Greece, human consumption of 'animal fodder' in bad years can be widely documented. In Karpathos, for example, bitter vetch was eaten as a

famine food during World War II, after first being ground and soaked to remove toxins. The Amorgos maslin allows human consumption of fodder at minimal social cost, however, because all wheat and barley crops are to some degree mixed: one poor individual buying 'barley' (the term used by the farmer who grew the crop) for his own consumption was able, on the strength of a slight admixture of wheat, to classify his purchase as the more acceptable 'migadhi'.

-Halstead and Jones 1989, 51

Wild fig, sloe, wild plum, wild grape, blackberry (*Rubus* sp.), capers (*Capparis spinosa*) and wild olive (Hansen 2005, 327-341 and Appendix), are all attested at Tenta, and are probable food sources, while some varieties of mallow (*Malva*) are also edible and were eaten in Roman times (Horace *Odes* 31.15). An example of *Avena* sp., oats, was identified in a context belonging to Period 3 (G 10 C, 21.1) (Hansen 2005, 334). Wild oats (*A. sterilis*), the ancestor of modern oats (*A. sativa*), is native to western Asia and often found as a weed among cultivated cereal crops. Modern land use includes dry-farmed carobs and olives, some intercropped with cereals (Held 1992, 98).

The mammalian fauna from Tenta were examined by Paul Croft (2005), who helpfully has published both element representation and epiphyseal fusion data. Almost all of the faunal remains come from periods 2-4, including material from contexts apparently transitional between two periods, or otherwise ambiguous (Croft 2005, 348). Sheep outnumber goat using most metrics: 83% vs. 17% of identifiable elements (Croft 2005, 353). Since sex/age data also indicate that all these species were exploited for meat, Croft has also calculated their likely relative contributions to the meat supply at the site, based on estimates for average adult weights and the

percentage of that weight which would be edible. These are reproduced in Table 2 below. As Croft himself points out, these figures, in using average adult weights, significantly overstate the contribution of pigs since so many more pigs than deer or caprines were culled before reaching adult weight (2005, 347).

The separation of faunal remains from different periods allows for the characterization of change over time in the representation of these taxa. Using Croft's estimates of meat weight, the contribution of fallow deer decreased from almost 50% in Period 3 to less than 20% in Period 1, the latest Aceramic phase at Tenta (Croft 2005, 356). There is some evidence to suggest that this represents a real decrease in the number of deer being taken rather than a proportional increase in the representation of other animals. The absolute number of identified postcranial fragments decreases from Period 4 to Period 2 (the two for which the best faunal data are available). Periods 1 and 5 yielded almost no faunal remains, and Period 3 many fewer of all species than either 2 or 4 (Croft 2005, Table 106a-c). Meanwhile, the absolute number of both pig and caprine fragments increases from Period 4 to Period 2. On the basis of the percentages of identified fragments, it is possible that Period 3 represents an interval in which deer were less important overall than were pigs (Croft 2005, 349), though Croft refrains from speculating about possible reasons for this unusually pig-heavy interlude. Croft estimates the contribution of deer to the meat supply at the site decreased over time from roughly 63% in Period 4 to 48% in Period 2, much less marked than at Khirokitia, discussed below (Croft 1991, Table 1).

Apparent change over time in absolute numbers of bones deposited is

complicated by any number of factors, as discussed above in Chapter 2. Most importantly, we do not know how long each of these phases was in years. In the chronological scheme used by the excavators, Tenta Periods 4 through 2 are placed in the Middle Cypriot Aceramic or the Cypro-LPPNB, which lasted from about 7500-7000 cal BC (McCartney and Todd 2005, 177). If Period 4 was of three hundred years' duration, and Periods 3 and 4 each 100 years, then we might expect a decrease in absolute numbers of bones deposited (in the absence of evidence for very high site occupation intensity such as a dramatic increase in population).

Skeletal element data hint at different patterns of butchery for deer than for pig and caprines (some of which may also have been hunted). The first and second phalanges of fallow deer are underrepresented both compared with other skeletal elements of deer and with the first and second phalanges of pigs and caprines. While the ratio of first to second phalanges is often used to test for recovery bias, in this case deer phalanges, which carry virtually no meat, may have been removed during initial butchery in the field and not brought back to site (Croft 2005, 346). The fact that deer metapodia, or cannon bones, another low-utility leg element, were not also removed, Croft attributes to their use in the bone tool industry of Tenta, in the manufacture of large bone points (Croft 2005, 346).

Again, the lack of information about the timing of epiphysial fusion in fallow deer makes analysis of age and sex mortality profiles less specific than they might otherwise be, while at Tenta dental eruption and wear give very different estimates for age at mortality; Croft prefers the latter as both more durable and less likely to be

mistaken for elements of mature smaller animals like caprines (2005, 350). Both fusion and teeth, however, indicate that a substantial percentage of deer, from 28% (epiphysial fusion) to 45% (teeth) were killed as juveniles or sub-adults: probably, Croft argues, young males which could safely be taken without affecting the herd's ability to maintain population (Croft 2005, 350).

As Croft has suggested, the fallow deer at Tenta, while larger than the English fallow deer used in Chapman and Chapman's study (1975), may have been slightly smaller in size than those at Ortos and at Chalcolithic sites in the Ktima lowlands (Croft 2005, 351; Croft 2003, 276). It is possible that this reflects human selection of larger animals, curtailing their reproductive potential, and partly offsetting the adaptive advantage for large size in bucks especially (assuming larger and older male fallow deer compete more effectively for does). Alternatively, environmental factors in the Vasilikos valley may have favored slightly smaller animals; or the apparent difference might be an artifact of the relatively small sample sizes involved.

Pigs were subject to a very different pattern of selection, with a large number of infants and juveniles culled. Fusion data reveals that 29% died as infants (< 1 year), 26% as juveniles (1 to 2 or 2.5 years), 17% as sub-adults (2 or 2.5 to 3 or 3.5 years) and 28% as adults (Croft 2005, Table 109). Dental data are generally compatible, suggesting 30% mortality by 1 to 1.5 years (Croft 2005, 353). The large number of piglets apparently eaten was made possible by the fecundity and tendency towards larger numbers of offspring exhibited by pigs relative to ruminants such as sheep, goats, and deer (Croft 2005, 353). A litter of piglets would have represented a reserve

of meat which could be extended over several months, from say six months after birth to four years, slaughtered either when game and other food was scarce, or in accordance with social demand for meat. Croft has suggested, however, that physical space put a limit on the number of pigs which could be raised in the immediate vicinity of the village (Croft 2005, 357).

Caprines at Tenta exhibit a somewhat different mortality pattern than either deer or pigs. Here too epiphyseal fusion data for modern populations reveal that fusion occurs at different times; and tooth eruption and wear patterns present a very different picture (Croft 2005, 354). Taking both sets of data into account, it seems likely that roughly half of caprines were slaughtered before reaching adulthood at 2.5-3.5 years, with anywhere from 7% to 26% before about a year (Croft 2005, 354). Here again, the higher figure, which comes from second molars without wear, is probably to be preferred, since fewer bones belonging to younger animals will have survived as compared with those of sub-adults and adults. Judging from the size dimorphism in scapulae and astralagi, those young caprines selected for slaughter were disproportionately male, in keeping with a culling pattern emphasizing meat (Croft 2005, 355). Mortality among infant and juvenile animals was therefore lowest among deer, somewhat higher among caprines, and highest among pigs, with their large litters and quick weight gain.

Croft looked at the spatial distribution of faunal material, but his conclusions were limited by the fact that so few of the deposits in which faunal remains were found are believed to have accumulated during occupation, as opposed to post-

abandonment (Croft 2005, 355). Croft attributes the presence of more pig bones in occupation deposits to the fact these bones, often of small, young animals, were more protected from weather and scavengers than were bones left outside structures (2005, 356).

Fox, cat, and rodents are represented in very small numbers (Croft 2005, Table 103) which do not permit any quantitative analysis of change over time. A broad sample of marine molluscs (Demetropoulos and Eracleous-Argyrou 2005) was recovered at Tenta, probably indicating that the aceramic Neolithic villagers treated the shore 2 km (or more) downriver as part of their “site catchment.” *Patella* and *Monodonta* are represented in low numbers, as compared with Aetokremnos, Shillourokambos, and Mylouthkia. The assemblage contains higher numbers of *Murex trunculus*, smaller but also edible.

Several examples of marine shell recovered seem to have been used as ornaments, as at Cap Andreas. A *Columbella rustica* has a bored hole (Demetropoulos and Eracleous-Argyrou). Dentalium shells were widely circulated in the PPNB, probably strung on cord, while *Spondylus* were exchanged among LBK communities in central and northern Europe. *Murex trunculus* is the source of a leucobase which when oxidized through exposure to heat and light produces a color-fast purple dye, and was exploited for this purpose in the Eastern Mediterranean from at least the Late Bronze Age and perhaps earlier (Reese 1979-1980, Reese 1987a, Reese 1987b, Burke 1999). However, it is not at all clear that they were ever used for dye in the Neolithic. Additionally, where *Murex* were used for dye production their shells are usually found

crushed, in very large quantities; if kept in tanks before the dye-extraction process their shells may also exhibit bore holes reflecting cannibalism (Reese 1987a, Burke 1999). *Charonia variegata* is the source of traditional conch-shell trumpets (Demetropoulos and Eracleous-Argyrou 2005, 369).

Todd has argued that Structure 34 at Tenta may have been used as a granary, based on its small internal dimensions (with a radius of just over 2 m) and the low raised bench around the interior wall, which suggests to him a raised wooden floor (Todd 1987, 102). Botanical evidence did not allow the identification of any of the pits in which carbonized seeds were found as storage facilities, with the possible exception of one pit from Period 3/4 (Hansen 2005, 326). It is interesting to note that the botanical contents of indoor and outdoor pits were not notably different (Hansen 2005). Nevertheless, it seems probable that at least some of these pits were used to store grain. For how long is another question. Halstead and Jones described a traditional Greek practice of burying grain in straw-lined pits for a few days in order to kill pests, before transferring the grain to wood or stone chests (Halstead and Jones 1989, 52). Stored underground long-term, grain may sprout (in which form it is edible), and is liable to rot as well as the depredations of other pests—if not the aerobic microorganisms and insects killed off by burial, to burrowing rodents, including, perhaps, the house mouse attested at Mylouthkia (Cucchi 2001, Croft 2003, Croft 2005, 355).

The preservation of the human remains recovered at Tenta was, like the faunal remains, generally poor. However, both mortuary and physical anthropological data

sets for Neolithic Cyprus are so small that these burials represent a valuable addition to the sample (Niklassen 1991, 106-109). The 14 burials from Tenta represent a minimum of 18 individuals, 8 adults, 2 children and 8 infants (Moyer 2005, 1). Children and adolescents are thus underrepresented compared with Neolithic populations elsewhere.

Moyer estimated male longevity at 30.5 for men and 35.6 for women, while adult stature averaged 162.9 cm for men and 153.8 cm for women, though the later estimate is based on only two male and two female individuals (Moyer 2005, 2).

None of the skeletal pathologies identified provide conclusive evidence of any nutritional deficiency or of any particular form of labor. Several individuals may have suffered thalassemia, sickle cell anemia, or iron deficiency anemia, common in malarial environments (Moyer 2005, 3) including some of the coastal villages of the Levant (Hershkovitz et al. 1990) and at other Early Prehistoric sites in Cyprus (Harper and Fox 2008). While preservation of teeth was not ideal, dental health seems to have been generally good. Only one instance of caries was recorded, on a molar (Moyer 2005, 3). Hypoplastic lesions, which can reflect malnutrition in early childhood, were absent, though this is more likely a function of the absence of children from the sample than an indicator of good dental health (Moyer 2005, 2). Overall, dental wear was low, compared with the people of Abu Hureyra and considering the likely importance of robust grains in the Tenta villagers' diet (Moyer 2005, 3).

The prevailing convention for burial was apparently primary single inhumation in a flexed position, with little preference for any one cardinal orientation (Moyer

2005, 3; contra Niklasson 1991, 109). There are several cases of multiple and secondary burial (Moyer 2005, 6). Both intra and extra-mural burials occur for adults and children; some structures were more often used for burials than were others, and adult burials within houses were usually in deep pits while infant burials were in shallow ones (Moyer 2005, 5). Extramural burials took the form of pits as well as a variety of other depositional contexts, some apparently expedient, though the corpses remained articulated (therefore were not scavenged) and some were carefully positioned (Moyer 2005, 6).

In summary, we have a small sample of the dead population and the osseous physical remains are poorly preserved. They exhibit little evidence of malnutrition or work-related pathologies, though tooth wear, caries, and anaemia affected some part of the population. Adults and infants of both sexes were generally deposited in simple inhumation burials without surviving artifacts, though one infant was interred with two lumps of red ochre (Moyer 2005, 6); the lack of durable markers of social roles in combination with a fairly strong social consensus about the treatment of the dead is consistent with an egalitarian society. There is no obvious evidence for violence in the dead population: no obvious parry fractures, healed wounds, or cranial fractures from the “mace heads” found at the site.

The low limestone bump on which the village is located was apparently a highly desirable situation for Aceramic villagers (cf. Kataliondas, Cap Andreas, and Khirokitia, below). Furthermore, mosquitoes notwithstanding, the Vasilikos itself may have been powerfully attractive. Neither mudbrick nor plaster can readily be made

without water. Neither should other riverine resources be underestimated. Fish and birds are not well represented in the faunal assemblage; however, this is probably due at least in part to the fact that their bones did not preserve as well as those of large ungulates and are not so readily recovered in excavation (outside of flotation). Reeds were probably used in dwelling construction, as well as for other applications such as basketry.

Using reasonably conservative estimates (about 7.8 people/ha supported with half of the arable land left fallow) Wagstaff obtains a potential population estimate of 830-1350 people supported by 1-km radius area, which is approximately the same as his estimates for 15-min walk and isochronic distance (Wagstaff 2005). This population figure is higher than the size of the physical settlement would lead us to expect, and it is probable that the disparity reflects a population well below the theoretical carrying capacity of the surrounding environment, in order to mitigate effects of famine years—to buffer the kind of stochastic variation that the “new ecology” has been shown to complicate the concept of static carrying capacities (Turner 2005).

Todd's survey of the Vasilikos valley (2004, 2005) indicates that there were other, perhaps contemporary Aceramic sites, for example at Mari *Mesovouni*, 2 km from Tenta and near the modern coast, and at Ora *Klitari*, 6 km upriver.

Geomorphological analysis indicates that the modern flood plain in the Vasilikos valley is now some 5.5 m higher than in the early Holocene, a depositional process which may have buried additional Aceramic sites located on the fertile alluvium. In

addition, it is theoretically possible that there was a dense concentration of sites on a part of the coastal plain now under water due to marine transgression (Gomez and Pease 1992). However, unlike the river bridge site, Skarinou *Kholetra*, Kalavastos *Angastromeni*, Kalavastos *Kafkalia V*, Argaki tou Yeoryiou, and Ora *Klitari*, Mari *Mesouvouni* is located by Held in a precipitation zone receiving 300-400 mm/year., just above the threshold for dry farming wheat. Today, agriculture in the area relies heavily on irrigation for the production of vegetable crops (pers. observation).

The presence of these other sites in the immediate vicinity of Tenta complicates analysis of the degree of resource stress faced by the Tenta villagers. For example, apparent changes in the deer populations upon which Tenta relied might be due not only to the actions of the villagers at Tenta itself, but also to predation by contemporary Neolithic villages in the Vasilikos valley, as well, perhaps, as Khirokitia, only 7 km or so to the west, and any other as yet unidentified villages in the Maroni river valley. Todd attributes the abandonment of Tenta at the end of the Cypriot Middle Aceramic Neolithic or Cypro-PPNB to environmental factors, perhaps a succession of bad years (Todd 2005, 383), but close site spacing and possible competition for resources may also have been factors. Held notes *Klitari* “occupies a strategic ecotone position above confluence of Vasilikos R. and major tributary, at W end of the E-W highland corridor” (Held 1992, 110), and may have been in a position to observe and restrict movement across the valley.

Like other Aceramic communities, Tenta seems to have maintained some connections with groups off the island (Todd 1987, 183-5; McCartney 2004). The

painted figures on plaster, use of red ochre, and some other aspects of cultural practice have parallels in Anatolia, as do certain architectural features (Todd 1987; Todd 2005; Peltenburg 2004). Obsidian is never abundant, perhaps due to the high quality of the different cherts used, but most obsidian occurs in Periods 4-2 (McCartney 2005, 194). As elsewhere on Aceramic sites, it appears to derive from central Anatolian sources (McCartney 2005, 194).

KHIROKITIA-VOUNI

Khirokitia *Vouni*, in the Maroni river valley of southern Cyprus, was long considered the “type site” for the Aceramic Neolithic on Cyprus (Dikaios 1961) but is increasingly seen as exceptional (e.g. Peltenburg 2004b), mostly because it is so large and falls at the end of the Aceramic period. It is positioned approximately 200 m above sea level, placed by Held, like most other sites on the south coast, in his vegetation zone 8: “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy,” receiving about 400-500 mm rain a year, and in a soil zone characterized by the “Interface of Calcareous Raw Soils and deep Xerorendzinas on limestones, chalks, Pliocene marls, and very deep calcareous deposits” (Held 1992, 98).

Dating of the occupation of Khirokitia is problematic, since radiocarbon dates do not accord well with the stratigraphy (Le Brun 1989, 17-20; Le Brun and Evin 1991; Le Brun 1994), but it seems reasonable to date the site to the early seventh millennium cal BC through the fifth millennium. It was first excavated by Porphyrides

of pollen cores, charcoal, and seeds. The seeds recovered in the excavations reflect mostly the domesticated cereals and legumes, and weeds like brome (*Bromus* sp.) that would have grown in cultivated fields, but also fig and wild plum. The presence of black bog rush, *Schoenus nigricans*, is no surprise given that Khirokitia is located within a bend of the Maroni river.

There are six published pollen cores from Khirokitia (Renault-Miskovsky 1989). Arboreal pollen is poorly represented throughout. However, at a minimum, a range of both temperate trees and characteristically Mediterranean thermophilic varieties are represented (Renault-Miskovsky 1989). The first group includes pine (*Pinus*), alder (*Alnus*), elm (*Ulmus*), hazelnut (*Corylus*), *Betulaceae*, and full size white oak (*Quercus pedunculata* or *sessiliflora*); the second group the small Kermes oak (*Quercus coccifera*), a component of maquis vegetation throughout the Mediterranean, *Pistachia*, undetermined *Oleaceae*, a family that includes wild olive but also ash, jasmine, and forsythia, cypresses (*Cupressaceae*), a category which includes juniper, box tree (*Buxus*), carob (*Ceratonia*) and hickory (*Carya*) (Renault-Miskovsky 1989, 253). Since the “pollen rain” can include pollen from species a considerable distance upwind of the site, the presence of, e.g., elm and hazel pollen does not imply that these species were necessarily present within a 3-km site catchment. Renault-Miskovsky expected *P. halepensis* at lower altitudes, but at least some of the charcoal has been identified as *P. brutia* (Thiébaud 2003, Table 2), which today is found primarily in the mountains.

An even wider range of non-arboreal plants is attested, mostly shrubby

xerophytic ground cover and flowering meadow-type vegetation. Many are not identifiable to species level from pollen, but the major groups include grasses (Graminae), naturally including cereals; the daisy family (Asteraceae), including Chicoriae which are well-represented throughout and dominant (80% of identified pollen grains) in some phases, Anthemideae, Carduaceae, and sage (*Artemisia*); Centaurea, Boraginaceae, Caryophyllaceae, Chenopodiaceae, Labiatae, Cistaceae, Fabaceae, Liliaceae, Convolvulaceae, Dipsacaceae, or the teasel family, Malvaceae, mallows broadly defined, and Ranunculaceae, buttercups (Renault-Miskovsky 1989, 253). Some aquatic plants are also present: *Potamogeton*, pond weed, *Sparganium*, *Typha*, belonging to the cat-tail or bullrush family, and Cyperaceae, sedges (Renault-Miskovsky 1989, 253). It is also worth noting the presence of plantains: *Plantago*, not the banana-like plantains of genus *Musa*, but edible nonetheless.

One of the most significant facts about the pollen data is that arboreal pollen is low throughout, at 2-5% in the lowest levels of the East (earlier) sector and at comparable levels for the lower part of Column 3 preceding the occupation of the West sector (Renault-Miskovsky 1989). The pollen data do not therefore support a heavily forested environment in the vicinity of the site ca. 7500 cal BP, at or before the start of the Atlantic humid phase (Robinson et al. 2005).

In both Levels III and A, arboreal pollen is very low, cereal representation quite strong, and grassy, steppe-type vegetation well represented (Renault-Miskovsky 1989, 261). Though the stratigraphy is uncertain, this provides environmental background for the intensive investment in sheep and the eventual abandonment of the

settlement, either

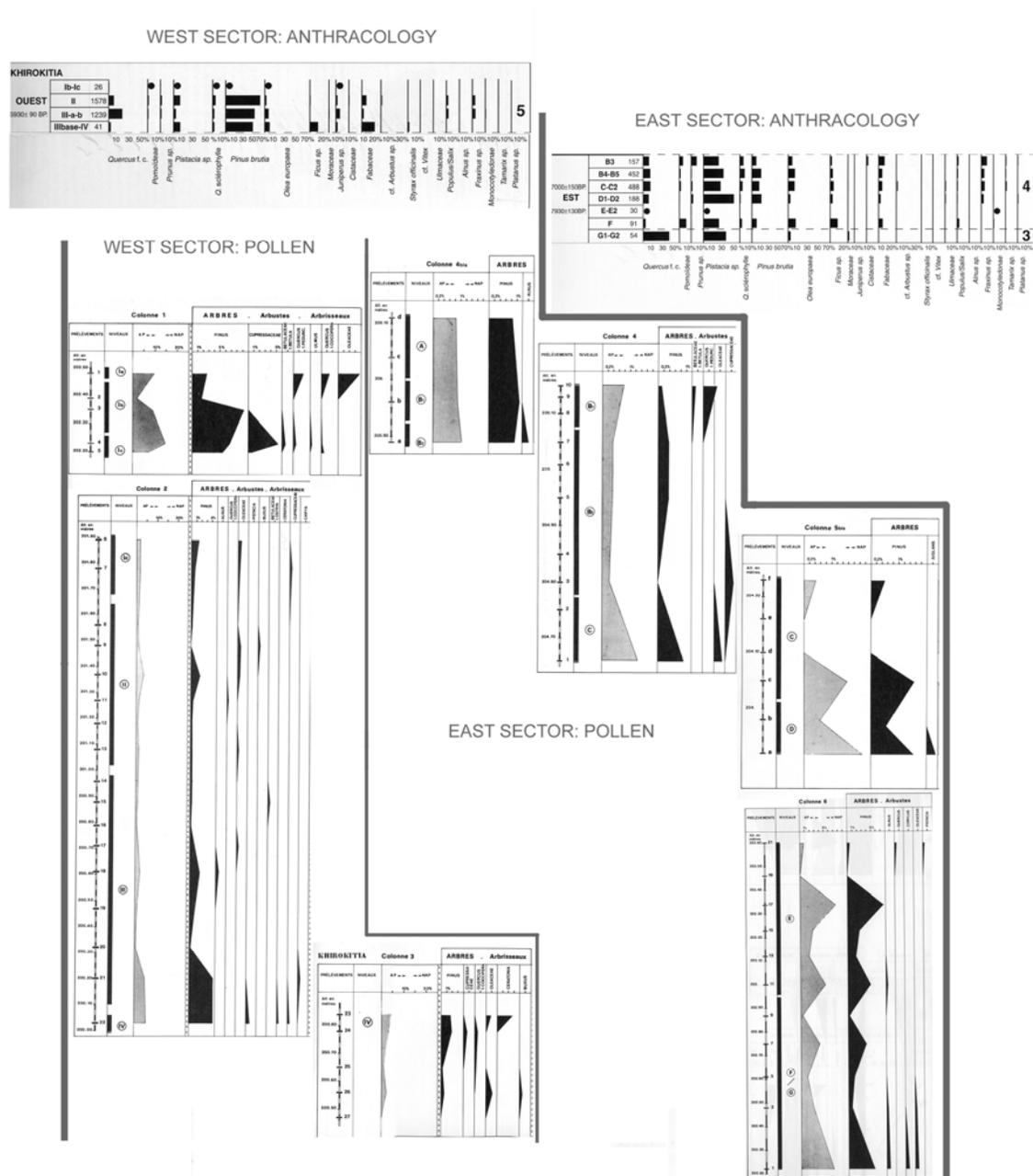


Figure 8. Pollen and anthracology data for Khirokitia (adapted from Renault-Miskovsky 1989, Figs. 68-71 and Thiébaud 2003, Fig. 2)

slowly (if III post-dates the abandonment of the East sector) or over a shorter time frame (if Level III is contemporary with A). Column I, with its high percentage of arboreal pollen and the absence of cereals, may represent reforestation after the abandonment of the village (Renault-Miskovsky 1989, 261).

Anthracological data reflect only those arboreal species which were burned, more or less precluding any straightforward comparison of species' representation in anthracological and palynological data sets (as argued above in Chapter 2). However, it is possible to ask whether the relative importance of a wood species attested in the charcoal evidence agrees with its relative representation in the pollen data, e.g., is pine better represented than oak overall, and does this change over time?

Oaks account for around 40% of all identified charcoal samples in Level G, but thereafter the number drops to around 10% for the remainder of the occupation of the East sector. In the West sector, oak accounts for less than 5% of samples in the lowest parts of Level III and Level IV, around 20% in Level III, around 10% in Level II, and is not represented in Level I (Thiébaud 2003, Fig. 2). Oak is very poorly represented in the pollen samples, even in the part of column 6 corresponding with Level G (Renault-Miskovsky 1989, 258-60). *Pistachia*, meanwhile, is relatively stable in the East sector at around 25-30% of samples, though it attains a level of 50% in Level D. However, it is not well represented in the pollen from the top of column 6, which corresponds with the base of D (Renault-Miskovsky 1989, Fig. 68). In the West sector, its representation is much lower, in the range of 5-10% (Thiébaud 2003, Fig. 2); and it

is barely represented among the pollen samples from columns 1 and 2 (Renault-Miskovsky 1989, Fig. 70 and 71).

Calabrian or Turkish pine (*Pinus brutia*) is consistently around 10-15% of samples in the East sector, but from 50% to over 70% in the West sector (Thiébaud 2003, Table 2). In pollen core 2, which corresponds to Levels IV-Ic, pine is rarely more than 2% of identified grains and never more than 5% (Renault-Miskovsky 1989, 258-260 and Fig. 70). In column 1, pine varies from 6 to 9% (Renault-Miskovsky 1989, 260 and Fig. 71). A greater percentage representation is not itself evidence for a resurgence in pine forest; simply evidence that more pine was burned. Fig, juniper, wild olive (*Olea europaea*), Fabaceae, and ash (*Fraxinus* sp.) contribute relatively low quantities of pollen (around 10% or less), though the Fabaceae represent about 20% of the sample for Level IV and the very base of Level III (Thiébaud 2003, Fig. 2).

The botanical remains from Khirokitia include einkorn and emmer wheat, barley, lentils, *Pistacia*, fig, wild olive, wild oats (*Avena* sp.) and vetch (Hansen 1989). Einkorn was apparently far more prevalent than emmer, at 33% as against to 5% of the total botanical sample (Hansen 1989, 237) though the ratio will have changed somewhat with the discovery of some deposits of emmer grains (Hansen 1991). Barley is present in very small quantities, though its uniformly poor preservation (Hansen 1989, 237) suggests the possibility that the sample is subject to differential preservation, i.e. better preservation of einkorn than barley.

Very few seeds of weed species were identified (Hansen 1991, 393). This may have something to do with the practice of floating those contexts which the excavators

believed likely to contain carbonized botanical remains (Hansen 1989, 237), rather than, as at Tenta, systematically sampling every context for flotation. In contrast to the botanical remains, pollen cores from the site (see below) reflect a significant number of weeds and waste-land plants, as well as pollen from species like hickory, carob, and cat-tails whose products could have made important contributions to diet (Renault-Miskovsky 1989).

The botanical assemblage does not reflect strongly patterned change in subsistence practice over time. Einkorn is dominant throughout (Hansen 1989, 1991); there is no sign of a shift from emmer to einkorn. Fig (*Ficus*) is very common in Level III, somewhat less so in Levels II and I, while wild olive is present in Levels II and IIIa, in very small quantities: a total of one whole seed and two fragments (Hansen 1989, 236). Very few wild plum seeds are reported (Waines and Stanley Price 1977; Hansen 1991). Pollen from wild olive, pistachio, and fig are all reported in relatively small quantities in the pollen cores from Khirokitia (see below) (Le Brun 1989, Fig. 71; and see my Figure 8 below, p. 137).

Several spatial concentrations of botanical remains deserve attention in the context of resource use. One is a raised platform in Structure 88, with nearly 80% glume bases and 2% grains of einkorn, plausibly interpreted as a processing area: perhaps, as Hansen suggests, a work area in which glumes were removed after wheat was parched (1989, 235-236). Another is the “grinding installation” in Level IIIa, near structures 87, 97, 93. The large sample (n >700 identified remains) from this area consisted of glume bases, rachis fragments, and other chaff (Hansen 1989, 236). These

suggest at least some cereal processing took place within the settlement, in contrast to much observed traditional agricultural practice, and perhaps help explain aceramic Neolithic people's apparent affinity for breezy hill tops. A large deposit of emmer wheat from Level G, and one of emmer mixed with lentils, from Level F, might imply that emmer and einkorn were grown and processed separately (Hansen 1991, 393). Wheat and barley, when grown and harvested together, can be separated using a screen, but the procedure would be much more difficult for einkorn and emmer since the grains are of similar size.

It would be useful to know how closely the levels of cereal pollen recorded at Khirokitia relate to actual amount of cereal grown: in other words, whether the pollen data reflect change in average wheat and barley production over the course of the occupation of the settlement. If so, long cores like Column 2 (Renault-Miskovsky 1989, Fig. 70) might reflect higher production of cereals in Level III, relatively low production for most of Level II, and a slight increase in Level 1c, with a gradual decline preceding the abandonment of the settlement. Experimental work might help establish relationships between pollen representation and crop production, and the degree of error to be expected.

Unlike most of the other sites discussed hitherto, Khirokitia provides evidence, however tentative, for physical storage of surplus in contexts other than pits. On the basis of charred grains of einkorn apparently associated with the collapse of the roof in Structure 85, Hansen has suggested that grain may have been stored in lofts or on the roof: the other possibility, of course, is that the presence of these grains was

incidental or they made their way into the mudbrick or plaster of the roof (Hansen 1989, 236). The soil samples from Level IV which produced so much of the einkorn were not taken from storage pits or other primary contexts, but rather from a fill deposit apparently put down before the construction of structures belonging to Level IIIb (Hansen 1989, 236). Le Brun has suggested that Structure 99 may have been used as a granary (Le Brun 1984, 63).

The Khirokitia faunal assemblage has been analyzed and commented on at several different points during the excavations (King 1953; Ducos 1965; Watson and Stanley Price 1973; Waines and Stanley Price 1977; Davis 1984; Davis 1989; Davis 1994; Davis 2003). In the earliest levels, caprines, pig, and fallow deer each make up about a third of the assemblage by NISP (Davis 1991, Table 1). The number of caprine fragments increases over time, to around 40% in levels C and B and from 59%-80% in Levels III, II, and I (Davis 1991, Table 1). Fallow deer increases gradually until Level D, holds relatively steady in Levels C and B, at about 40-43%, but falls off rapidly in Levels III, II and I, from 25% to 9% NISP (Davis 1991, Table 1). Pig exhibits a steady decrease over time, from 33% in Level F to 19% in Level B, from 15% in Level III to 10% in Level I (Davis 1991, Table 1). Croft's estimate (1991) for the contribution of these species to the meat supply at the site over time is reproduced in Table 2, below.

It has generally been argued and accepted that the Khirokitean faunal assemblage reflects a decrease in the contribution of deer to diet over time, with intensification in the raising of domestic stock, primarily sheep (Davis 1989, Wasse 2007). However, this decrease in the number of identified remains of deer and in their

proportional contribution to the faunal assemblage is most strongly marked only in Levels III, II, and I, the West sector of the site. Deer exhibit a rather small decrease (from 45% to 40% NISP) in Levels E through B (early to late), and a much more significant drop, from 30% to 9% of NISP, in Levels III to I (Davis 1989, 195 and Table 4a). The number of deer remains recovered from Level B is actually higher than the number of identified remains from sheep/goat and pig. The chronological relationship between the West and East sectors is still in need of clarification, but Level A is likely to be contemporary with at least one of Levels III, II, and I (Davis 1989, Table 1). Thus, there seems to be a degree of spatial as well as temporal patterning in the deposition of deer remains. Possible explanations include depositional factors, taphonomic processes, including scavenging by canines, which are attested in the fauna (Davis 1989), and differential consumption of fallow deer in the two sectors of the site. The latter is obviously an intriguing possibility.

There is also an apparent change over time, however tentative, in the proportion of young versus adult animals taken. Deer metacarpals from Level D are 100% fused; those from Level C 73% fused, those from Level B 64% fused, those from Level III 71% fused (combining data taken from Davis 1989, Table 5b; Davis 1991, 331-332). This establishes a tentative trend of more juvenile animals taken over time. It is next possible to ask whether this trend indicates more intensive herd management with increased culling of young males, a less intensive herd management strategy in which deer of all ages and sexes were taken at the same time, perhaps in a group hunt (as, apparently, at Skillourokambos) or something else.

In Level B, many more females than males were identified based on a bimodal size distribution of distal humerus measurements and distal metacarpals in combination with epiphysial fusion of metacarpals to identify young males which might otherwise have been classed as females (Davis 1991, 308-11). The prevalence of female deer is high in contrast to Level C, in which males are better represented (Davis 1991, 311). There is thus no linear trend over time towards taking more males or more females.

There are essentially two scenarios in which it makes sense to eat a high proportion of female deer. One is where the deer population is so large relative to the demands placed on it that culling females does not put pressure on the deer population. This includes all hunting strategies in which whole herds are taken at the same time, and in which their members are taken individually but indiscriminately. The other is a scenario in which the human population's short-term need is so great that obtaining calories in the short term takes priority over ensuring the long-term viability of deer populations, or conformity with any social pressures which exist to promote that end.

It may be instructive here to look at some rough numbers. While all of the inputs for this model are open to debate, the goal is to arrive at a rough order-of-magnitude minimum estimate of how many deer might need to be culled in a typical year to support the largest Aceramic Neolithic settlement in Cyprus. Let us first assume that Khirokitia had a population on the order of magnitude of 500 people (see discussion of scalar stress below), with people of all ages and both sexes consuming

on average 1500 calories/day (Kelly 1995; Hawkes 1991; Hawkes et al. 1991). Yearly caloric requirements for the settlement would then be 273,750,000 calories. Assuming people needed 25 g/protein/person/day (somewhat lower than the USDA recommended allowance of 0.4 g/lb of body weight per day), minimum total yearly protein intake for the settlement would be in the range of 4,500,000 g or 4,500 kilos. If animal protein provided 1/3 of total protein, with the remainder coming from plant sources, 1,500 kilos of animal protein would be required each year.

For the sake of this model, I set average live weights for adults of the taxa consumed at Khirokitia as follows: pig, 75 kilos; caprines 50 kilos; deer 55 kilos (based on data in Chapman and Chapman 1975, Croft 1991, Simmons 1999, and elsewhere). Many juveniles in all three taxa are represented, so perhaps it is better to use 50, 35, and 40 as average (not mean) live weights, with 50% of that for meat weights, exclusive of fat but including protein-rich organs such as hearts, and livers. If we accept that MNSI gives a roughly accurate picture of the relative prevalence of the different species (40% caprines, 40% deer, 20% pig), then we obtain the following values:

$$300 \text{ kilos pig} / 25 \text{ kilos protein per animal} = 12 \text{ pigs}$$

$$600 \text{ kilos caprines} / 17.5 \text{ kilos protein per animal} = 34 \text{ caprines}$$

$$600 \text{ kilos deer} / 20 \text{ kilos protein per animal} = 30 \text{ deer}$$

34 caprines, 30 deer, and 12 pigs per year would have satisfied the minimal lean

protein requirements for 500 people if they were getting 66% of their protein from vegetable sources and 33% from animal sources (a conservative estimate). These figures allows for a higher proportion of smaller (juvenile) animals than appear to be actually reflected in the faunal record (Davis 1989, 197-206).

To cull 30 individuals a year sustainably, how large a total deer population would the inhabitants of Khirokitia have needed to draw upon? This depends on natural population growth rate before human predation, which in turn depends of a variety of factors including carrying capacity of the environment and predation. Humans were likely the only predators capable of taking adult deer, but the foxes attested at Aceramic sites might be expected to have accounted for a certain number of fauns. Let us say that a total annual mortality rate of less than 30 percent, including an equal number of males and females, results in population stability. If half of this rate represents culling by humans, then a total population of 200 deer would allow a cull of 30 per year.

What size catchment would such a population need? This again is dependent on a host of variables influencing the availability of browse. One study of a population of fallow deer (*Dama dama*) in a submediterranean environment without large predators observed a population density of over 1000 animals in an area of some 4650 ha, or 46 km² (Apollonio et al. 1998). The catchment of the Vasilikos valley was estimated by Gomez et al. (2004) at just over 150 km². Allowing for an early Holocene environmental regime somewhat wetter than the present day, with more abundant browse, it seems likely that this valley or the neighboring Maroni valley in

which Khirokitia is situated would have been able to support a deer population large enough to provide these villages with from 30%-50% of the meat they consumed, provided they derived around 60% protein from vegetable sources. This does not account for deer migration from other areas of the island less subject to human predation, or for seasonal variation in deer body fat, which can be substantial (Chapman and Chapman 1975).

Obviously, this model is just that: a model. Its inputs are subject to debate, and different inputs will produce very different results. Further, it should not be assumed that environmental parameters represent a “steady state” ; rather, there will have been considerable interannual variation in the carrying capacity of the environment. Nonetheless, it provides a context for thinking about herd management strategies reflected in the faunal record. The implications of this model for resource stress at Khirokitia and in the Early Prehistoric generally are discussed below, and in Chapter 6.

To return to the other large mammals at Khirokitia, it is interesting to note that, as Davis has shown, sheep became larger in size (as well as more abundant) between Level B and Level III (1991, 308). Davis cautiously suggests “breed improvement,” (1991, 308) perhaps as a result of the introduction of new stock from the mainland (Peltenburg et al. 2001). These will most likely have been hairy rather than woolly sheep, presumably exploited almost exclusively for their meat. Pigs exhibited no apparent change in size: for the duration of the occupation of Khirokitia, the same “large, primitive breed” was raised (Davis 1989, 197)—and perhaps hunted, if there

was a feralized wild population.

Apart from the ungulates, animal species identified at Khirokitia include cat (*Felix*), dog (*Canis*), fox (*Vulpes vulpes*), and fossilized pygmy hippopotamus (*Phanourios minutus*) in very small numbers (Davis 1989, Davis 1991). None are likely to have made a major contribution to diet. In their relatively small sample, Watson and Stanley Price identified rock dove (*Columba livia*), ducks (*Anatidae*), a large snake, a toad, and a fish belonging to the genus *Sparidae* (breams), in addition to rodents, some of which may have been intrusive (Watson and Stanley Price 1973). Watson and Stanley Price reported (1973) the rodent remains from their test excavations as *Mus musculus*, house mouse. Other mice and shrews have been identified in subsequent work (Davis 1989).

The bony fish assemblage from Khirokitia is considerably smaller than that from Cap Andreas (Desse 1984, Desse and Desse-Berset 1989). It consists almost entirely of *Epinephalus* (merous) and *Sparidae* (breams). Both are represented by a full range of skeletal elements (Desse and Desse-Berset 1989, 225). The fish probably varied considerably in size, but seasons of capture were unable to be determined due to the encrustation of the bones and their generally poor preservation. Desse and Desse-Berset argue that while fish of smaller size were probably taken, they may not have been transported the 6 km back to the site (1989, 224). While most of the fish remains came from Levels II, C, B1 and D1, it would be unwise, given the small sample size, to interpret this as evidence for increased fishing activity in these levels.

Of the marine invertebrates at Khirokitia, *Monodonta* was one of the most

prevalent, at over fifty identified fragments, while *Murex*, *Charonia variegata* (conch), *Spondylus*, and *Columbella* were represented in smaller numbers (Demetropoulos 1984). Numerous pieces of *Dentalium* shell were recovered. As Demetropoulos has commented (1984, 179), many of these are visually attractive as well as edible, and the use of *Dentalium* for beads throughout southwest Asia is well known. A surprising number of the *Monodonta* shells are complete. *Helix cincta*, land snails, are well represented but may be intrusive. The molluscs are published by context, but the data do not reveal any strong change in their consumption over time.

Very few bird remains were recovered. The 1977-1981 excavations produced two examples of *Columba palumbus* (wood pigeon), and one each of *Corvus corone* (carrion crow) and *Ciconia ciconia* (European white stork) (Pichon 1984). Wood pigeon and crow are both native to the island today and both prefer woodlands (Pichon 1984). The white crane is an occasional seasonal visitor as to Cyprus as to most other Mediterranean islands during its seasonal migrations, and may have been hunted during these predictable appearances (Pichon 1984, 164). Otherwise there is little evidence that birds made a significant contribution to diet at any stage.

The faunal data have also been used to support various inferences about the environment. Pichon, for example, suggests that the presence of the wood-pigeon implies the existence of forests (1984, 164). Davis has argued that the apparent increase in sheep reflects deforestation and habitat degradation (1991, 306-308), reconciling this with the palynological data by claiming fauna reflect local conditions to a greater degree than pollen, while at the same time admitting that economic

specialization in sheep need not be causally related to environmental change (Davis 1991, 308). In connection with this issue, Alex Wasse, referring to Rollefson and Kohler-Rollefson's work at Ain Ghazal (Rollefson and Kohler-Rollefson 1993), posits that the apparent intensification in sheep husbandry at Khirokitia in Levels III and II might have been used to reduce pressure on the site's "degraded catchment" (Wasse 2007, 63). Of course, this depends on the animal husbandry strategies employed: whether the animals were penned near the site, fed fodder, and grazed in the fields, or pastured elsewhere. Clarke has suggested that the location of Khirokitia, "the first settlement reached [by people abandoning Aceramic settlements in the north and migrating south] upon rounding the south-eastern edge of the Troodos" (2007a, 99) might have made it an inviting place to settle for people on the move. An influx of people—perhaps traveling with flocks—might well have exacerbated existing social tensions (Clarke 2007a, 99).

Despite intensive and careful investigation of the built environment at Khirokitia, there is no direct evidence for storage beyond pits, both inside and outside structures. The possibilities that grain may have been stored in lofts inside some structures, or that partitioned "radial buildings" might have had a function related to storage, have already been mentioned. A textile impression (Le Brun 1991, 299-300), perhaps a woven mat of some sort of vegetable fiber, suggests that basketry may have been used for storage and other applications.

Khirokitia has produced the largest dead population of any aceramic Neolithic site on Cyprus, at well over three hundred individuals (Angel 1953, Kurth 1958,

Charles 1962, Stanley Price and Christou 1973, Taramides 1983, Domurad 1986a, Niklasson 1991, Le Mort 1994, Le Mort 2003). The skeletal remains suffer the same problems of preservation as elsewhere on Cyprus. Burials are both intramural, within structures, and extramural; all ages from neonates to mature adults are represented, though the number of adolescents is very low (Niklasson 1991, 59). Males and females are represented in nearly equal numbers (Niklasson 1991, 61). Nearly all were primary and individual interments, with the dead person placed on his or her side in a flexed position, sometimes on his or her back (Niklasson 1991, Le Mort 1994).

The western extension of the village of Khirokitia in the last phases of the Aceramic Neolithic is plausibly interpreted as reflecting an increase in population—provided that it does not coincide with abandonment of other sectors, e.g., the north part of the village (Le Brun 1989, 63). But if the size of the settlement produced scalar stress requiring the development of new social structures or relations (Johnson 1981; Wobst 1974), such structures were not reflected in the treatment of the dead in an archaeologically recoverable way. There is little evidence for the differentiation of specific social roles beyond male/female, though varying numbers of stone vessels were deposited in some burials, and the placement of these vessels over the head or torso and their treatment, specifically their perforation or deliberate breakage, suggests some ritual action (Le Mort 1994). In addition, necklaces of alternating dentalium and carnelian beads seem to have been deposited only in female burials (Le Brun 1997, 27). Otherwise, provision of artifacts with dead person varied considerably. One man was buried with a picrolite “pin,” stone tools, fragments of animal bones, and a

reddish stone; a woman of perhaps 30-35 was buried with a selection of chert flakes and tools, a bone needle, red pebbles; many others were buried without any grave goods that survived (Dikaios 1953; Niklasson 1991).

Cranial deformation by occipital flattening was present in somewhere from 40% to more than 50% of the skulls examined by Angel (Angel 1953, 416; Angel 1961, 229). It is attributed to the use of cradle boards to which infants were tightly bound (Angel 1953, 416). It is worth noting, in passing, that some later anthropomorphic representations from the prehistoric Bronze Age of Cyprus may depict infants secured to cradle boards (for discussion and recent bibliography see Talalay and Cullen 2002; Knapp 2008, 97-102). It is possible that adult individuals who did not exhibit occipital flattening either were not subjected to binding on a cradle board or “recovered” from its effects (Angel 1953, 416). Infants which did not exhibit occipital flattening might either not have been subjected to binding on a cradle board, or to have died before it produced occipital flattening. Thus, it would seem unwise to take flattening as *prima facie* evidence of different groups within the community at Khirokitia.

Several adult men showed signs of healed skull fractures and other trauma. One adult man had a depressed fracture on the left frontal; another a healed fracture of the left zygomatic arch (Angel 1953, 416; Niklasson 1981, 61). These are especially interesting since they are both (at least superficially) consistent with blunt force trauma. Another adult man sustained, and survived, several traumatic blows to the jaw, right frontal bone, and back of the head (Fischer 1986; Niklasson 1991, 61).

However, interpersonal violence is not the only possible cause of cranial fractures, and though several cases of leg fractures have been identified (Niklasson 1991, 61) there are no obvious “parry” fractures (tibia and fibula). The skeletal pathologies identified do not point towards any obvious resource stress such as dental hypoplasia or evidence of malnutrition. Adult males were 1.61 m tall, on average, and adult women 1.51 m. Life expectancy (presumably calculated for an individual who survived infancy) was about 35 years for men and 33 for women (Angel 1953; Angel 1961; Le Brun 1997, 27). Based on the shapes of reconstructed skulls, Angel called Khirokitia “a relatively inbred population” (Angel 1961, 228) with few obvious affinities, at least in terms of cranial morphology, with later Ceramic Neolithic populations (cf. Le Mort 2003; Harper and Fox 2008).

In conclusion, while Khirokitia is in some respects the best-documented of the known Aceramic Neolithic sites on Cyprus, in other respects it remains enigmatic. In order better to understand its subsistence economy, we would particularly like to have more information about storage practices, the timing of the apparent expansion of the village beyond the physical precinct marked by the boundary wall around the East sector; the nature of connections with the mainland and relations with other contemporary sites on Cyprus, and the circumstances of site abandonment.

ADDITIONAL SETTLEMENT EVIDENCE

The sites reviewed above are by no means the only Aceramic sites known (or suspected) on Cyprus (Stanley Price 1979; Todd 1987, 180-181; Held 1992). As in the

case of the Vasilikos valley, even where sites provide insufficient data to evaluate their subsistence economies, their locations can provide clues to the environmental constraints which acted on Aceramic settlement and people's patterns of movement. In relatively few locations is survey data quality high enough confidently to infer the *absence* of sites, but many inferences can be drawn from the *presence* of sites attested in gazetteers and survey data.

Petra tou Limnati, a Cypro-PPNB village site on a small offshore island off the northwest coast, was identified and excavated by Einar Gjerstad (1934). Unfortunately this early excavation provided few environmental data, but this site provides a parallel for Cap Andreas in its coastal location and the limited arable land adjacent to the site.

Dariusz Maliszewski has identified nine sites and isolated structures possibly belonging to the Aceramic Neolithic in the uplands of northwestern Cyprus and the river valleys emptying into Chrysokhou Bay (Maliszewski 2007). These provide important confirmation that people were taking advantage of upland environments not just in the neighborhood of Ais Yiorkis and Ortos, but in the northwest of the island.

Little is known about Trakhoni-*Vounaro* in the Akrotiri peninsula (Heywood 1982, 167), though survey by Albert Ammerman and others has identified several sites in the Akrotiri peninsula which may be very early, possibly tenth or ninth millennium (Ammerman et al. 2008). Klepini-*Troulli* is another north coast site, in Kyrenia district, about 10 km from the city of Kyrenia (Dikaios 1962, 63-72; Peltenburg 1985: 100-101). Also in Kyrenia district is the site of Akanthou-*Arkosyko*, apparently belonging to the Aceramic Neolithic (Sevketoglu 2000, 2002).

The site of *Ayia Anna-Perivolia* in the Tremithos valley, 10 km inland and west of Larnaca, was identified by Baudou and Engelmark (Baudou and Engelmark 1983). However, the lithics at this site appear to have been redeposited from elsewhere, and its date is uncertain, though unlikely to be Paleolithic as originally suggested (Todd 1987, 181). *Phrenaros-Vounistiri* is located about 5 km inland from Famagusta (Stanley Price 1980, 122). Again, its dating is uncertain. An Aceramic site at the locality of Bellapais near Kyrenia has been recorded, but not extensively studied (Dikaios 1936(1), 74; Stanley Price 1977; Held 1992). Some of the sites in the northeast foothills of the Troodos massif documented by the SCSP and Elaborating Early Neolithic Cyprus project (McCartney et al. 2005, 2006) are likely to have been visited or occupied in the later Aceramic Neolithic. The overall impression is one of substantial activity outside the walled villages which have hitherto attracted most attention.

DISCUSSION

As argued above in Chapter 1, we often have better evidence for mechanisms or strategies for coping with resource stress than for the stress itself. Indeed, the better these mechanisms or strategies were at dealing with the effects of periodic resource shortages, the more pronounced this disparity is likely to be; and if certain archaeologically attested behavior is assumed to have provided insulation against resource stress—stress inferred in turn only from the presence of the behavior—argument quickly assumes a circular nature. I have argued that it is necessary to

distinguish carefully among evidence for the nature of resource stress, for its probable periodicity, for the nature of coping or buffering practices and strategies, for variability among these practices and strategies at different levels (households, villages, etc.) as the archaeological data permit, and evidence for change in practice over time.

Evidence for the nature of resource stress for the Aceramic Neolithic farming communities of Cyprus is largely probabilistic and conjectural. There was then, as there is now, stochastic and therefore unpredictable variation in many environmental parameters. Of these, precipitation and soil moisture will have been two of the most important for early farmers, with soil moisture periodically falling below the minimum needed for a successful wheat harvest, though thanks to a slightly cooler and wetter climate regime, such failures may have been less frequent than in historical periods (Christodolou 1959). Topographic relief affects precipitation and local geological features: streams and rivers, obviously, but also non-cereal vegetation cover and the depth and character of sediments, water retention and transpiration, all factors contributing to the fine-grained spatial variability in growing conditions characteristic of the Mediterranean (Grove and Rackham 1999). All this has been addressed above in Chapters 1 and 2 in some detail, and it is unnecessary to rehearse it here at great length. However, it is important to point out three sources of risk which may have disproportionately affected Neolithic agriculture and subsistence practice: the problem of establishing a farming package still “in development,” certain limitations imposed by the lack of animal labor, and the 8.2 ka cold interval after the Early Holocene Wet

Period.

The initial stress on cereal crops until they were well established in a generally favorable location or locations (Willcox 2003) might have lasted a few years or a few generations. An initial crop of maslins, perhaps along with ryegrass, vetches, and legumes, would have provided a certain amount of information, as farmers could see which cereals and legumes had done well under observed conditions. But it might take a long time before farmers had an idea about the productivity of different fields under different weather conditions, how frequently a field should be fallowed (if indeed fallow rotation was used), and so on. Initial settlement might have involved the laborious clearing of more land area than needed to support the settlement until farmers determined which areas would support which crops, and the same probably applies to the establishment of “daughter” villages in the case of village fissioning (see below).

As suggested above, the lack of animal traction may have contributed to a spatial concentration of cereal crops, or at least a less dispersed pattern than that which has often been observed in studies of traditional Mediterranean agriculture (Halstead 1987, Halstead and Jones 1989). Fields need not have been in the immediate vicinity of settlements, though this has obvious advantages: less time spent in traveling to and from fields, greater ease of monitoring crops and defending them from birds, deer, and other pests, shorter transport distance at harvest time. Spatial concentration of crops obviously makes them more vulnerable to localized events such as hailstorms, high winds, and fire. Wild plant foods were subject to these and other

pressures, including anthropogenic ones. Watkins has asserted that in the Aceramic, foraging for wild resources was more important than growing cereal crops (1979, 20; 1981, 144-5). Frankly, it is extremely difficult to come to a good understanding of the relatively importance of cereal crops and wild plant foods with the present state of the evidence, though settlement evidence suggests a preference for regions with both light, arable soils and access to the resources in ecologically distinct areas (e.g., upland forest, riparian zones on the banks of streams or rivers, and sea coast). However, it is safe to say all of the 5-km catchments of known Aceramic Neolithic sites contain enough currently arable land to support populations much larger than are likely to have lived in the Neolithic villages.

Finally, the so-called “8.2 ka cold event,” a climatic fluctuation identified in GISP2 and Vostok ice cores and believed to have affected the Mediterranean (Robinson et al. 2005), represents a longer-term potential source of stress. Broodbank suggests that while it may have adversely affected or even killed off large numbers of both farmers and foragers around the Mediterranean littoral, farmers may have recovered more quickly, opening the way for either “leapfrog” or “wave of advance” demographic dispersal (Broodbank 2006, 215). Clarke (2007a) and Wasse (2007) have noted that this secular environmental change in fact apparently had few identifiable negative effects on farming villages in Cyprus as compared with the mainland, which they attribute to low population and low resource pressure. If Broodbank is correct, we might reasonably expect to see an increase in the rate of the wave of advance in the aftermath of the 8.2 ka event; however, no such “bounce” is visible on Cyprus.

These and other sources of stress appear to have been adequately addressed through a variety of economic strategies: diet breadth, mobility and sharing, and low absolute population and population density (Clarke 2007a). Intensification of food production is not notable before the late Aceramic, when at several sites sheep herding seems to have become a much more important part of the overall subsistence strategy than it had been previously. Evidence for storage of surplus is for the most part inconclusive, since few pits can be positively identified as storage features based on their contents. Evidence for community fissioning, which may be linked to social scalar stress as well as resource shortage or abundance (Bandy 2004, Peltenburg 1993) is generally absent, and there is likewise little evidence for violent competition for resources.

Evidence for diet breadth comes from faunal and botanical assemblages, both subject to poor preservation in Cypriot soils. However, at nearly all the sites discussed, emmer, einkorn, barley, lentils, pea, vetch, *Pistacia*, pig, sheep and goat, and fallow deer were present, along with a range of wild plant species which can be expected to have grown in the vicinity of the sites. Watkins's assertion that wild resources were more important than cereal crops (1979, 20; 1981, 144-5) is difficult to test using the botanical evidence, but should still be considered a viable hypothesis. Certainly catchments were heterogeneous: while all would support domestic cereals and livestock (in very different proportions), the range of wild resources available was quite different. Carter argued that geological similarities among Neolithic sites on Cyprus equated to similar catchments and therefore “can be expected to result in

similar exploitation strategies” (Carter 1989, 250). However, examination of the geological map of Cyprus suggests the geological heterogeneity of even small site catchments for Ais Yiorkis, Ortos, Mylouthkia, Khirokitia, and Tenta.

These disparities are if anything more significant when it is recognized that similarity in underlying geology does not necessarily equate to similarity in soils, especially where those soils are the product of large-scale depositional processes. Furthermore, local ecology will be profoundly affected by precipitation and vegetation regimes, dependent to a certain extent on soils, true: but the same soil can support any of several different vegetation regimes (Vita-Finzi 1978). The area around Ortos might have been wooded, even heavily wooded (Simmons 1994, 3), while the Maroni and Vasilikos valleys are likely, based on the paleobotanical evidence discussed above, to have hosted a mixture of open woodland, maquis, and riparian plants.

Wasse sees “agriculture fading into the background soon after its introduction to Cyprus” (2007, 62). It might be as accurate to say that what was introduced to Cyprus were first-generation agricultural strategies which were subsequently modified in different ways than they were in the Levant. As Willcox notes (2003), farming appeared on Cyprus “while agriculture on the mainland was still in what might be interpreted as the consolidation stage.” Assuming the Cypro-EPPNB farmers at Shillourokambos and near Mylouthkia were free agents in choosing location of their settlement—that they were not heavily constrained by, for example, the territorial claims of people already living in the area—they seem to have tried to maximize their exposure to number of different resources available from coastal plains, upland areas,

and the sea itself, rather than to a concentration of any one resource. Clearly, sources of fresh water were important for all aceramic farming communities, but the nature of these sources varied—wells, spring-fed streams, rivers fed primarily by precipitation and snowmelt.

The abundance of different sorts of wild resources varied dramatically: for example, the very high representation of wild olives at Shillourokambos, the high figures for *Pistachia* elsewhere, the importance of fish at Cap Andreas. Site locations may also be related to Willcox's proposal (2003) that the tolerances of cereal crops and the best locations for them locally had to be determined by trial and error. Some communities may have relied heavily on maslins as a hedge against rainfall shortage, resulting in mixed harvests of *mighadi*. Only at Khirokitia is there evidence for possible monocrops of emmer wheat, which occurs by itself and with lentils. It might have been separated from the barley fraction of maslin by sieving, but not from einkorn, the grains of which are similar in size.

The relative contributions of different species to the animal economies of these villages at different times vary considerably. Particularly notable in this regard is the apparent absence of cattle from sites in the eastern part of the island. Equally interesting is the relative importance of pig. According to Wasse (2007), the transition from (as he argues) pig-based economies to a heavy reliance on hunted fallow deer represents a sort of “economic de-intensification” not possible on the Levantine mainland, eventually followed at the end of the Aceramic by a period of “intensification” in the form of sheep husbandry. In the Cypro-MPPNB and well into

the Cypro-LPPNB, pigs remained important alongside fallow deer. Dhali, where pigs were only 7% or 9% of the assemblage overall, is the exception (Croft 1989). Otherwise, they were 30% NISP at Ortos and 38% at Ais Yiorkis, around 33% overall at Tenta, where they may have been more numerous than deer in Period 3 (Croft 2003, Simmons 2003, Croft 2005). At Cap Andreas they actually increased in importance over time, to 46% of the assemblage by NISP in Level IV, before subsequently declining (Davis 1981). Shillourokambos and Khirokitia both saw marked declines in the representation of pig, from 74% in early phase A at Shillourokambos to about 25% thereafter, including the Recent phase, and at Khirokitia a decrease from 33% to 10% (Vigne et al. 2003, Davis 1991). While it is tempting to link this with the decline in oak pollen at Khirokitia (see above), acorns are hardly the only or even the primary food on which Neolithic pigs would have subsisted.

Davis, apparently understanding fallow deer as managed herds of almost-domestic animals, has argued that “Neolithic people with their domestic food animals probably did not hunt to any great extent” (1989, 193). I have argued that there is no reason to believe that deer were not introduced to the island as wild animals and subsequently hunted. It is possible to envision a closer relationship, with fallow deer as one of Redding's (1995) “failed experiments” in domestication, but there is little evidence to support this view. In any case, a reliance on fallow deer is everywhere evident by the Middle Cypriot Aceramic Neolithic. Though people at Shillourokambos may have been taking whole herds of deer or at least taking deer indiscriminately with regard to age and sex, nearly all other deer assemblages show some selection aimed at

maintaining herds (Croft 1993). Where sites were close together and apparently contemporary, as in the Maroni and Vasilikos river valleys, heavy reliance on deer herds might have introduced a degree of competition among villages, potentially a source of stress.

Unlike the Natufian and PPNA sites analyzed by Munro (2001, 2003), at no Aceramic site on Cyprus was the small animal fraction of the faunal assemblage large and well-preserved enough to permit analysis of changes in the investment of energy in the pursuit of small game. While preservation of small bones was almost uniformly agreed to be poor, it is likely that large ungulates made an adequate contribution to the site such that smaller terrestrial game such as rabbit and tortoise were never exploited in really large numbers, a sign of generally low resource stress.

Aceramic Neolithic farmers on Cyprus are not unique in their heavy reliance on (non-domesticated) ungulates: fallow deer are a major component of Natufian assemblages in the Levant and Upper Euphrates valley, while gazelle form a major component of Aceramic Neolithic faunal assemblages across southwest Asia (Kujit and Goring-Morris 2001, Simmons 2007). Hunting, as opposed to animal husbandry, introduces a higher degree of short-term risk to provisioning, since hunters can hardly depend on encountering game with the same reliability as herders. Among foragers, the risk of coming back from a hunt empty-handed is often addressed by a strong sharing ethos, one of the few features occurring world-wide in a high percentage of foraging groups (Kelly 1995), and the same sort of sharing ethos, at least with regard to hunted meat, may have existed among early agriculturalists on Cyprus.

It is generally and reasonably assumed that the farming communities of the Cypro-PPNB were egalitarian, implying not that resources were perfectly equally distributed or that there was no asymmetries of power or status; rather, that the social group probably possessed habits and practices that worked to minimize inequalities, while such disparities as exist in the sizes of structures and treatment of the dead are unlikely to reflect a strongly ranked, stratified society.

At Tenta both pits and hearths were primarily outdoors, and therefore both storage and food preparation would have been, to an extent, “public” activities, with important implications for sharing and reciprocity (Flannery 1972; Boyd 1994; Hayden 1995; Watkins 2004). It is interesting to find no significant difference in the botanical contents of indoor and outdoor pits at Tenta (Hansen 2005). At Khirokitia, cereals (and presumably other plant foods) were apparently ground in “courtyards” outside the structures, while cooking may have taken place indoors at hearth installations (Le Brun 1997, 22). If so, practice at Khirokitia differs from that at Cap Andreas and Tenta, where both grinding and cooking took place outdoors. Preparation and consumption of food in a space shielded from the view of other community members might have strong social implications in an egalitarian society, especially in such a large settlement as Khirokitia, which may have been subject to scalar stresses (Wobst 1974; Johnson 1981).

At none of the sites reviewed above do we have good evidence for specialized storage facilities. Some of the pits found at Tenta, Khirokitia and other sites were probably used for the storage of surplus, though none yielded large numbers of grains

or seeds. This absence of evidence limits our understanding of the degree to which individuals, households, or kin groups were responsible for producing and distributing food. In later periods, storage is one of the most important categories of evidence for changes in how physical surplus was used to buffer against the effects of bad years (see Chapter Five).

It seems highly likely that the total population and population density of Cyprus both remained very low compared with, for example, the southern Levant. Assessing prehistoric populations from archaeological evidence often involves a very high degree of expected error. Since not all known sites must be settlements, since parts of settlements like Khirokitia may have been occupied while other parts were abandoned, and since populations may have been relatively mobile for agriculturalists, size does not correlate perfectly with population, but it is a reasonable proxy for relative population, though populations at sedentary village sites certainly changed over time (Todd 2005). However, individually and collectively, Cypriot Aceramic sites have small occupied areas³:

Khirokitia: perhaps 2.5 ha

Kataliondas: 2 ha*

Cap Andreas: undetermined, perhaps 1 ha

³ These estimates are based on site visits and do not always accord with those of the original surveyors or excavators; I have not been able to visit Cap Andreas. Knapp (forthcoming) presents a slightly different set of estimates.

Dhali Agridhi: undetermined, probably < 1 ha

Shillourokambos: 1 ha

Tenta: 0.26 ha

total: 8.76 ha

It is worth noting that a single PPNB Levantine site, 'Ain Ghazal, covered about 9 ha at around 6500 cal BC (Rollefson 1989), while “mega-sites” were even larger (Kujit and Goring-Morris 2001; Simmons 2007).

The question of site spacing presents a different set of problems with an equally wide range of error possible. By no means the whole island has been subjected to surface survey, and since even intensive survey can miss sites that are buried, eroded, or very small (Todd 2005) it is unsafe to assume that we have anything like a complete map of all the Neolithic villages on Cyprus. The available data give little or no reason to infer a dramatic increase in the population of Cyprus over the course of the Neolithic (Clarke 2007a), as has sometimes been argued for the mainland. Ain Ghazal grew from 4-5 ha in the early 7th millennium cal BC to 12 ha at its greatest extent, at the end of the 7th millennium ; it continued to grow after Jericho and Beidha were apparently abandoned (Rollefson 1989). Incidentally, its expansion took a definite toll on the local environment (Kohler-Rollefson and Rollefson 1990), to a degree seen nowhere in the Cypriot Aceramic Neolithic. It is possible that the conservative subsistence economies of Cyprus had a lower potential for dynamic

change in maternal energetics than those of mainland sites (Bocquet-Appel 2009).

Evidence for connections with mainland groups in the form of obsidian, chipped stone technology, and certain architectural features such as radial buildings is likewise limited, but there can be little doubt that groups on Cyprus had regular contact with kin and affinal groups elsewhere in southwest Asia (Peltenburg et al. 2001; McCartney 2004). Guilaine has argued (2000) that the decrease in arrowheads and disappearance of cattle from Shillourokambos by the Cypro-LPPNB represents evidence of the isolation of Cyprus, a breakdown in relations with mainland groups. However, there are still cattle at Ais Yiorkis and Ortos, and points at Khirokitia and Kissonerga (Peltenburg et al. 2001, 53). The changes at Shillourokambos could just as easily represent a long-term local adaptation to a local environment which was less than ideal for cattle, or the result of internal cultural changes which discouraged the keeping of these large and “expensive” animals, even in small numbers, in favor of a balance of sheep, pig, and fallow deer, as elsewhere on the island.

Assuming that contact with mainland groups continued over the course of the Aceramic, and that many areas of Cyprus were not undesirable territory for farmers, why was there apparently so little redistribution of population from heavily populated areas to the island? Implications for the “wave of advance” model of farming dispersal and patch defense in Shennan's (2007) “ideal despotic distribution” model are discussed in Chapter 6.

The small communities of the Cypriot Aceramic do not appear to have been subject to frequent fissioning, either in response to social tensions or to environmental

stresses. However, it is extremely difficult to test for in this particular data set (cf Bandy 2004). It is worth considering briefly why fissioning does not seem to have been common. Surely the pressures identified by Peltenburg (1993) could have provided an incentive to split the community, exacerbating existing social tensions and encouraging population to seek out resources elsewhere.

For early agriculturalists, in contrast to mobile foragers, village fissioning probably required a significant investment of labor and physical surplus, perhaps making it ill-suited as a response to overall less favorable conditions. The foundation of a new village would likely require both surplus labor, for clearing and tilling fields, constructing shelters, and so on, and surplus stored grain, for establishing crops locally: all the work of “niche creation” to do again, which farmers might ill be able to afford in the aftermath of a bad harvest. Additionally, it is worth noting that not only sedentary villagers but many foraging groups, those of central Australia for example, have complex rules about access to resources. In the case of splitting an Aceramic village, rights to fallow deer herds, favored stands of oaks and wild olives might all have to be re-negotiated.

Some of these disincentives are reduced with an increased emphasis on ovicaprid husbandry, since flocks of sheep and herds of goats are partible and more readily controlled by individuals and kin groups than are groups of wild deer. Towards the end of the Cypriot Aceramic Neolithic, many sites experienced a transition from predominantly deer-based economies to ovicaprid husbandry, especially of sheep. While this has been argued to relate to environmental change or catchment

degradation in the vicinity of the sites in question (Wasse 2007), independent evidence for change in the local landscape is inconclusive. Shillourokambos is the first site at which there is evidence of such a transition, though it cannot be equated with any catchment degradation. Additionally, it should be noted that the intensification in ovicaprid husbandry in the Recent phase at Shillourokambos, which ends around 7000 cal BC (Vigne et al. 2003) appears to precede the transition from deer hunting to intensive ovicaprid husbandry in the West sector at Khirokitia by a millennium or more, depending on the dating of Level III. Caprines form nearly 50% NISP of the faunal assemblage at Kholetria Ortos, in the 7th -6th millennia cal BC, more or less contemporary with the increase in sheep husbandry at Khirokitia noted above. The large number of sheep and goats in Well 133 at Mylouthkia suggest that herding was highly important for the residents of whatever community was associated with the wells.

The increased trend towards ovicaprid husbandry at sites across the island which otherwise had a degree of diversity in their subsistence strategies suggests the possibility of some kind of strong pressure favoring herding (Wasse 2007). This may have happened in the context of greater aridification (Wasse 2007, 62), but given that the phenomenon happens at different times at different sites, global or regional environmental change is not a particularly persuasive explanation, and I have argued there is little evidence for local “catchment degradation” even at Khirokitia. Might the emphasis on herding in the later Khirokitean be a response to social stresses in village communities, to a breakdown in the egalitarian ethos?

Evidence for violence is conspicuous primarily by its absence. Villages like Tenta and Khirokitia are walled, artifacts interpreted as mace heads have been identified at several sites, and three individuals at Khirokitia exhibit evidence of head injuries (see above). Other evidence for the dis-articulation of skulls is generally regarded as relating to a tradition of ancestor veneration deriving from one that found at some mainland PPNB sites, as for example at Neolithic Jericho, rather than the decapitation of enemies (Niklasson 1991; Kujit and Goring-Morris 2002). Though the excavators of Mylouthkia have not interpreted the deposition of caprines in Well 133 as the result of a raid, it suggests that a goal of such raids, if they took place, might have been to destroy an enemy's flocks and herds and possibly even the quality of their water supply. At best, then, this is an absence of strong evidence rather than evidence of absence.

Elsewhere in the world, violent intergroup conflict is now understood to have existed among groups of foragers around the world before their contact with or incorporation into expansionist states (Kelly 1995; Burch 2005), as well as among sedentary agriculturalists competing among themselves (and with foragers) for territory. As Kent Flannery and Joyce Marcus wrote of the Formative in the Valley of Mexico, “We began our work at San Jose' Magote expecting to uncover the houses of peaceful farmers. Today we realize that intervillage raiding had begun almost as soon almost as soon as there were neighbors to raid” (Flannery and Marcus 2005, 99). Intergroup violence features implicitly or explicitly in several models for demic diffusion, the spread of early villages, and increases in socio-political complexity: it is often

linked with population pressure and competition for circumscribed resources (Carneiro 1970). Given that both neither high population density nor resource stress is convincingly attested, it is perhaps not unsurprising to find so little evidence for violent conflict in early farming communities on Cyprus.

In short, of the common risk-management strategies or responses described above in Chapter 1, there is evidence for the following: use of a broad spectrum of resources, social spacing, mobility, sharing, and niche creation. On the other hand, evidence is lacking for physical storage of surplus, community fissioning, and violent competition for limited resources. The nature of risk, subsistence practice, and risk-mitigation strategies varied from site to site. Early farmers “settled into” their landscape over the course of generations, and the resulting adaptations were locally-situated, flexible, and interlinked. Through niche construction, they modified their environment to create favorable conditions for themselves, moderating the selective pressures operating on them. High investment in land, tilling (without animal traction), planting, weeding, and the removal of rocks and weeds are activities with appreciable returns on energy invested, up to a point of rapidly diminishing returns. It is also useful to consider the careful management of herds of wild animals and attention to water sources, as at Mylouthkia, as “niche maintenance.” Not all niches have the same potential, and presumably not all of the strategies and practices reflected in the archaeological record of Aceramic Neolithic Cyprus were perfectly or equally adaptive in evolutionary terms. However, there is little evidence for strong selective pressure favoring some groups over others based on their locations and

strategies, until the later Aceramic, when most invested increased energy in ovicaprid husbandry. It was not long after this transition that the latest Aceramic sites were apparently abandoned.

CHAPTER 4

SUBSISTENCE PRACTICE IN THE CERAMIC NEOLITHIC

This chapter examines evidence for variation and change in subsistence practice in the Ceramic Neolithic of Cyprus. As in Chapter 3, relevant faunal, botanical, and other environmental data are reviewed on a site-by-site basis, and changes in strategies at the site level are noted. In the second part of the chapter, resource stress and subsistence practice are considered in comparative perspective and at the regional level.

Between the last occupations of Aceramic Neolithic sites on Cyprus and the succeeding Ceramic Neolithic there is an apparent hiatus of perhaps some 500 years, if we take the the early dates from Kantou *Kouphovounos* as the start of the Ceramic Neolithic (Mantzourani 2003), or roughly a millennium, using a more traditional dating scheme (Clarke 2007a, 18). In either case, this apparent hiatus is based on a limited set of radiocarbon determinations and may turn out to be illusory, or to represent a period of dislocation and high mobility, by land and sea, rather than a total abandonment of the island (cf. Peltenburg 2003; Clarke 2007a). The Ceramic Neolithic remains arguably the most enigmatic period of Cypriot early prehistory and the most impoverished in terms of environmental data.

A striking feature of the Ceramic Neolithic is a number of reoccupations of Aceramic sites, as at Tenta and Dhali *Agridhi*, the implications of which are discussed more fully below. Overall, settlements often consist of built villages with rectilinear but monocellular architecture, often with rounded corners; there are also a number of partially or entirely subterranean sites like *Ayios Epiktitos Vrysi* and *Kalavassos Kokkinyoia*.

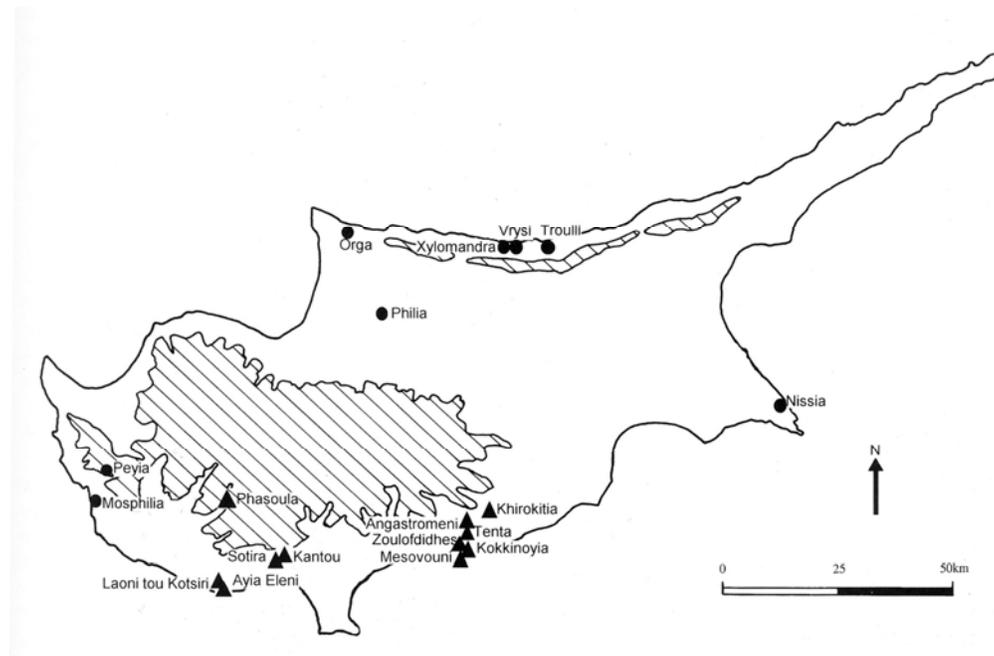


Figure 9. Late Neolithic sites represented according to whether Red-on-White (circles) or Combed Ware ceramics (triangles) predominate (adapted from Clarke 2007a, Fig. 2.5)

The adoption of ceramics on Cyprus lags the mainland by two millennia, a fact sometimes cited as evidence of extreme conservatism or even “cultural retardation” (Held 1993). It appears that people on Cyprus knew of ceramic technology in the

Cypro-PPNB, but did not adopt it (Clarke 2007a, 109, note 1). When pottery did appear, it bore little resemblance to contemporary Anatolian or Levantine ceramic fabrics; rather, ceramics had a dark, burnished fabric similar to much earlier pottery from the Levant and to fifth millennium ceramics from a small region in central Syria; however, it soon developed to encompass a range of ceramic wares and styles including Red on White and Combed Ware (Clarke 2001, Clarke 2007a). These came to exhibit considerable regional variation, with RW predominating in the north and west and CW in the south of the island; these wares continued into the Chalcolithic (Bolger 1991).

While the adoption of new technologies is never without consequences for survival and reproduction, there are many other possible reasons for variation in rates of change in behavior and material culture (Clarke 2007a). The adoption of pottery is not synonymous with cultural “progress,” and indeed Dark Burnished ceramics on Cyprus existed alongside stone bowl industries whose products are in many respects similar to those of the Aceramic. Ceramic evidence is not the focus of this study, but it is important for what it reveals about the context of food presentation and consumption, often divorced for analytical purposes from subsistence strategies (Hamilakis 2000) though the two were undoubtedly linked, as I have argued in Chapter 2. However, ceramics are considered here primarily in their capacity as tools for storing, preparing, and presenting food, rather than as media whereby information about group affiliation was communicated visually. Much more detailed work about technological change and ceramic style is available elsewhere (Bolger 1988, 1991;

Clarke 2001, 2007a).

Excavated settlements have provided some evidence for spatial patterning of both ritual activities and craft production in Ceramic Neolithic settlements. A striking feature of the Ceramic Neolithic is the significant differences among mortuary practice among different sites (see below). These correspond at best ambiguously with regional ceramic styles (Bolger 1991), suggested that the definition of group identities was complicated and expressed through multiple behavioral and material channels. Recent work by Joanne Clarke (2001, 2007a, 2007b, 2009), Eleni Mantzourani (2003), Pavlos Flourentzos (2003), and others has gone a long way towards elucidating the nature of cultural groups on Cyprus in the Ceramic Neolithic, but much more work is required if ecological relationships between human communities and their environment are to be really understood. However, the available information suggests that resources stress was different than in earlier and later periods; while its relationship to social change cannot be confidently ascertained, this is an issue for future research. As with the previous chapter, the first section of this chapter presents evidence for subsistence behavior and resource stress at a selection of sites; the second section is a brief discussion of variability and change over time, though these are even more difficult to characterize in the Pottery Neolithic than in the Aceramic.

DHALI-AGRIDHI

The Ceramic Neolithic phase at Dhali-Agridhi (discussed above in Chapter 3) is dated to 4465 +/- 310 BC (Lehavy 1989, 209), or, recalibrated with Intcal 04, 4690-

4450 cal BC at 1 sigma (Clarke 2007a, Fig. 2.3). The ceramics consist primarily of Dark-Faced Burnished Ware (DFBW). The Aceramic and Ceramic Neolithic areas of the site are adjacent and even overlapping, with no clear stratigraphic superposition. It was the opinion of the excavators that “the faunal and floral exploitation was basically the same” in the Aceramic and Ceramic Neolithic periods (Lehavy 1989, 211). Presumably this means wheat and barley were also recovered for the Ceramic Neolithic areas of the site. The lentils eaten were morphologically wild (*Lens orientalis*) based on size (Lehavy 1989, 210). One crop that was apparently an addition in the Ceramic Neolithic is wild grape (*Vitex silvestris* / *Vitis vinifera*). Whether these had always been native to the island, or were transplants, has not been definitively determined (Lehavy 1989, 210), but their general absence at Aceramic sites and presence at Ceramic Neolithic ones suggests they were introduced. The implications are discussed below.

As with the Aceramic Neolithic, the material at the site is not immediately informative about subsistence and resource stress. One large bowl may have served either as an oven or a vat for processing olive oil (Lehavy 1989, 210). Olives and olive oil are, of course, one of the great stored resources in the Mediterranean, with a liter of olive oil representing not only in the neighborhood of 8000 calories, but a vital, reliable source of lipids. Processing olives for oil is a season activity requiring substantial time and knowledge. If olive oil processing could be confidently documented at Dhali-Agridhi, through residue analysis or some other means, it would shed considerable light on the nature of the occupation there.

PHILIA DRAKOS

Like Dhali, *Philia Drakos* near Morphou may precede the main phase of the Ceramic Neolithic. The settlement consists of a ditch and defensive wall enclosing subrectilinear structures of varying sizes and subterranean features which are difficult to interpret (Watkins 1966, 1968, 1969a, 1969b, 1969c, 1970, 1970, 1971, 1972, Croft 1991). The sample of postcranial bone fragments recovered in excavation is so small (n= 252) that relatively little confidence can be placed in percentages, but the distribution of animal species based on Croft's analysis (Croft 1991) is reproduced in Table 2. The very heavy dependence on fallow deer is characteristic of the Ceramic Neolithic⁴.

SOTIRA-TEPPES

The site of Sotira-Teppes in southern Cyprus was excavated by Porphyrios Dikaios and served as the type site for his "Neolithic B" (Dikaios 1961, Dikaios 1962). The site is located some three kilometers or so inland and about the same distance west of the Kouris river, and thus lies north and west of the Ceramic Neolithic sites of Kantou Kouphouvounos and Erimi (see map, Figure 9). Dikaios attributed the location of the settlement at Sotira to two factors: first, its position on a hill in a basin, with advantages for defense and "surveillance over the wide and

⁴ A final report for *Philia-Drakos* is forthcoming (and appears in the bibliography of Clarke 2007a) but I have not been able to see this manuscript.

pleasant country from which the inhabitants obtained their subsistence,” second, the presence of perennial springs (Dikaios 1961, 218). Springs and hilltop locations are a recurring feature of the Ceramic Neolithic and Chalcolithic, one discussed below in more detail. Held located it in his climax vegetation zone 8: “Maquis of Carob and Lentisk, replaced below 350 m asl. by Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy” (Held 1992, 112). Sotira, at 320 meters asl, has elements of both these vegetation regimes. It lies in a zone typically receiving 500-600 mm of rainfall annually, and a zone of calcareous raw soils (Held 1992, 112).

The ceramics from Sotira are typologically later than those at Vrysi (discussed below), but the radiocarbon dates from Sotira span a range of 4450-3780 cal BC, both an earlier and a longer occupation than attested by the sequence of 17 radiocarbon dates from Vrysi (Dikaios 1961, 214; Clarke 2007a, Figure 2.3). This problem remains to be resolved (Clarke 1998, 2001, 2007a). It is widely recognized that ceramic style varied regionally and the adoption of new decorative techniques happened at different times in different places.

Flotation was not yet in common use in Cyprus when Sotira was excavated, and thus no botanical remains were recovered. Only 31 animals were identified from the bone assemblage, with nine identified to species (Zeuner and Ellis 1961). Of these, Mesopotamian fallow deer, *Dama mesopotamica*, is the best represented, at 19 elements or 76% of the assemblage (Zeuner and Ellis 1961, 236; Ducos 1965, 4). The reliability of this figure is low, given the small size of the sample, but it is comparable

to larger assemblages (Croft 1991). One pair of goat horn cores had an “almond shaped” cross section (Zeuner and Ellis 1961), and it may have been this animal to which Dikaios referred as a “mouflon” (1962, 82). A scapula and three phalanges were attributed to an ass or hermine (Zeuner and Ellis 1961, 236). If this identification is correct, it represents the earliest appearance of that animal on Cyprus, but it may have been misidentified (see Croft 1988a). Smaller animals are attested by a bird radius and a tooth identified as belonging to a fish or reptile (Zeuner and Ellis 1961, 236). Overall it seems likely that the animal economy at Teppes was similar to that at Ayios Epiktitos-Vrysi, discussed below (Croft 1991) though of course it would have been useful to be able to compare them in more detail.

Considerably greater attention was paid to the recovery and analysis of the skeletal remains of humans at Teppes. People were generally interred in single flexed inhumations in cists outside and between houses. Published data detail cranial measurements believed to indicate membership in putative racial groups (Angel 1961). Angel estimated the average age at death of seven preserved adult skulls at 36.4, slightly higher than his estimate for Khirokitia (Angel 1961, 227). He found that females had a consistently lower life expectancy than males, which he attributed to deaths in childbirth (227). The pathologies identified were primarily dental in nature. One individual suffered from caries and had lost molars, while another exhibited pronounced tooth wear (12 CS) (Angel 1961, 224-7). Angel argued that the shapes of the skulls from Sotira were sufficiently different from those at Khirokitia as to imply a different genetic background. Sotira, he argued, “could hardly have drawn its

population directly from the Khirokitia group” (1961, 228) unless founded by a few especially “long-headed” Khirokitians (or, given the radiocarbon gap, descendants of such Khirokitians). Additionally, it appears that cranial deformation, common at Khirokitia, was not practiced at Sotira (Angel 1961, 229).

Structures at Sotira vary considerably in size, plan and internal layout. Most structures are monocellular, but a few are multicellular. A continuum of rectilinear, sub-rectilinear, and curvilinear structures, some circular and others oval, are present. Phase I, the earliest stratigraphic phase at the site, saw both circular and rectilinear structures; rectilinear ones dominate in Phase II, but Phase III saw the construction of numerous structures, rectilinear, round, and oval, such that “the village became a veritable maze of houses of various types, rounded, oval and rectangular, with composite houses of two or three rooms appearing here and there” (Dikaios 1961, 220; cf. Flannery 1972; Saidel 1993; Flannery 1993). Phase III ended with a destruction that Dikaios ascribed to an earthquake; the structures of Phase IV were essentially bases for ephemeral superstructures not dissimilar to those which may have been constructed by people in southern Cyprus in the succeeding Early Chalcolithic period.

Evidence from inside structures reveals that, to varying degrees, storage, food preparation, and consumption all took place inside at least some of the time. Areas for storage, usually corners of a structure or an arc against the wall of a curvilinear structure, were typically marked off with low partition walls, a feature that recurs in Middle Chalcolithic houses (see Chapter 5). A variety of pits within structures were interpreted as storage features, as were indoor troughs, some cut into floors or even

the bottoms of pits, some built up with slabs (Dikaios 1961, 162). Grinding installation often occurred inside structures, sometimes in association with storage pits (Dikaios 1961, 161). Dikaios noted that food processing equipment tended to occur in groups (Dikaios 1961, 166).

Hearths were divided by Dikaios into six types (1961, 158): platforms, pits, platforms with pits, masonry hearths, and so on, but it might be equally useful simply to consider them, like house shapes, to have been morphologically variable, representing a range of different uses. Some structures have single hearths, others, like House 9, multiple hearths, and there does not seem to have been a standard location for hearths within structures, again unlike the highly standardized layout of later Middle Chalcolithic structures (Swiny 1989; Peltenburg 1998).

The ceramic assemblage from Sotira contains many vessel forms, wares, and decorative treatments. Though the ceramic Neolithic as an entity is considered to exhibit less variation in ceramic style than the Chalcolithic, the combed and painted decoration nonetheless may have conveyed information about household and community affiliations (Clarke 2001, Clarke 2007a). The information the ceramics provide about storage, presentation and consumption of food is limited, but important. Bowls of sizes appropriate for single servings are common in finer wares such as Red Lustrous, while spouted bowls are an especially common shape (Dikaios 1961, 172). Also in Red Lustrous are jars of a sufficient size to have been useful for storage, in ovoid, globular, and hole-mouthed shapes. While ceramic technology was undoubtedly important, stone vessels also continued to be manufactured, almost

exclusively in limestone. Dikaios thought them inferior to the sophisticated andesite vessels from Khirokitia, but that they compared well with Aceramic limestone bowls (1961, 189). There is no information from residue analysis or obvious contextual associations to reveal their specific functions, but their numbers do not decrease over time and innovation in their forms as late as Phase III suggests the roles they played, whatever these were, continued to be important.

By virtue of taking place indoors, household storage, cooking, and consumption were shielded to a large degree from the observation of other community members, removing them from the enforced sharing notoriously present not only among groups that live by foraging—but, in different forms, in sedentary village ones (Speth 1990; Peterson 1993; Sahlins 1972; Flannery 1973). This was neither an absolute nor a unilinear change, but nonetheless represents an important development, inasmuch as it would have conditioned procurement and storage strategies and practice at every level from that of individuals and households to those of villages and the society.

AYIOS-EPIKTITOS-VRYSI

The site of Ayios Epiktitos-Vrysi is on the north coast of Cyprus (see map, Figure 9). It was identified by the Cyprus Survey and excavated by Edgar Peltenburg (Dikaios 1962, 3; Peltenburg 1982a). Held locates Vrysi in vegetation zone 9, “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper, with or without Carob and Wild Olive under localized Aleppo Pine canopy,” in a precipitation zone

enjoying approximately 400-500 mm of rainfall a year (Held 1992, 86). Soils are predominately terra rossa on limestone kafkalla bedrock (Held 1992, 86). The planned program of research at the site was cut short by the Turkish invasion of the Republic of Cyprus in 1974. Vrysi nonetheless provides one of the most important ceramic sequences as well as the most coherent series of radiocarbon determinations for the Aceramic Neolithic (Clarke 2007a, 15-22). The area of the site is estimated at 800 m² or 0.08 ha, though the site may have been larger in prehistory: an unknown fraction of its area has eroded into the sea. A significant feature of the settlement is the investment of labor in creation or modification of hollows in the aeoleanite, or fossilized dunes, hollows which sheltered the structures at the site and must have given the village at least a partially troglodytic aspect. Peltenburg estimates a minimum of 630 person-days were involved in the creation of these hollows before the construction of the stone and mud brick structures in them, or the wall and ditch in the South sector (Peltenburg 1982a, 12). While a week's labor for 100 people is a significant investment by any measure, it seems likely that this will have been a small fraction of the total labor costs of establishing the settlement—clearing fields of vegetation and rocks, producing ground stone tools, the construction of animal pens.

Botanical remains from Vrysi naturally include wheat, of which emmer wheat was the most common, while both bread wheat and single-seeded einkorn were more prevalent than 2-seeded einkorn, barley, and lentils (Legge 1982b, 89; Kyllö 1982, Table 10). In addition to these major cultigens, archaeobotanical work also recovered

rye, peas, chick peas, fig, wild grape, apple, and olive (Kyllo 1982). Of these, apple stands out from the usual repertoire of East Mediterranean domesticates and familiar wild plant foods.

The total faunal assemblage numbers around 1000 bones: Legge blames the small size on the proximity of the sea, a bone's throw from the site (Legge 1982b, 78). There are large differences between the assemblages recovered for the Early Phase (with a sample size of under 100 elements, including teeth) and that for the site overall, as reflected in Table 2, below. Legge argues, however, that these percentages are skewed by the contexts from which animal remains were recovered. He is able to show that the representation of fallow deer in middens is much higher than that of pig or sheep/goat in those contexts, while a full 60% of the sheep and goat remains recovered derive from floors, as opposed to only 30% of the deer remains and 8 % of the pig remains. Such spatial patterning is not evident at Aceramic Neolithic sites. It would be most interested to test whether it appears at other Ceramic Neolithic villages, but the treatment of the archaeological record for this period does not permit such investigation.

The depositional pattern might reflect differences in consumption practice; perhaps arising from the social significance with which different animals were invested in early farming communities (Russell 1995). If flocks represented the personal property of individuals, kin or affinal groups, they might have been consumed disproportionately in interior spaces shielded from view, leading to a higher proportion of pig and ovicaprid bones on house floors. Likewise, if hunted deer were

not subject to the same strictures of ownership as domestic stock, they might have been consumed in outdoor public feasts and their bones disproportionately deposited in middens. Clearly this is not, at this stage, a testable proposition, but it suggests the sort of patterns that might be able to be discerned with well contextualized faunal data from settlements like Paralimni *Nissia* and Kantou *Kouphovounos*, discussed below.

A very low number of fallow deer teeth and mandibles were recovered, such that when bones and teeth are combined, the representation of this taxon site-wide drops to 38%, with sheep and goat accounting for 51.3 % and pig 10.7% (Legge 1982b, Table 8). Deer antler used in the bone tool industry at the site was reasonably excluded from the determination of NISP and MNI because most of it had been shed and was thus collected in the countryside rather than from living animals (Legge 1982b, 87). Those bones of fallow deer which are underrepresented—teeth, mandibles, metacarpals, metatarsals, and limb bones—cannot be accounted for by the use of some long bones in the production of bone tools (Legge 1982, 81). Underrepresentation of these elements of fallow deer probably relates to hunting, processing and perhaps consuming deer away from the settlement (Legge 1982b, 82). Precisely how this worked in the context of coastal settlements close to one another as Vrysi and Troulli (below) is uncertain.

Though Legge cautions that the sample size is small, which makes it difficult to test hypotheses about size groupings, distal humerus measurements clearly indicate two clusters of fallow deer, one larger and one smaller. The larger probably representing differential selection of adult and male deer, a pattern similar to most

Aceramic Neolithic sites (see Chapter 3). Size data do not support Davis's argument for an overall size reduction in fallow deer over the course of the Late Pleistocene and Early Holocene (Legge 1982b).

Among the ovicaprines, goats were more abundant than sheep, with 2 metacarpals identified to sheep and 12 to goat (Legge 1982b, 84). Recovered horn cores were fragmentary (Legge 1982b, 84), but it seems safe to assume that at this point in time we are to expect the exploitation of morphologically domestic sheep and goat, although the exploitation of hunted feral sheep and goat, which probably continued on the island throughout the hiatus between Aceramic and Ceramic Neolithic, should not be ruled out.

Peltenburg has raised the possibility that the dogs attested in such numbers in the faunal assemblage were used to protect fields from animal pests (Peltenburg 1982a, 99). While they would have produced a reduction in attrition by deer, rodents, and other wild critters, the presence of dogs might also have reduced opportunities for “garden hunting”: taking or snaring the unwary animals that came to eat standing crops. If defense was a concern for Ceramic Neolithic settlements, another possible role for dogs is as an early warning system (cf. Burch 2005). Finally, one butchered dog from a Chalcolithic context at Mylouthkia (see below) suggests they may also have been exploited for meat, perhaps in situations of extreme need.

Marine resources were likely an important component of diet at Vrysi. Unlike the inhabitants of Aceramic Cap Andreas, the inhabitants of Vrysi apparently hunted sea turtles. These animals still make seasonal visits to Cyprus to lay their eggs. The

representation of turtles by NISP in the published assemblage is unclear: the published list of elements contains fragments of carapace, (Legge 1982, 85-86). Overall, exclusive of carapace fragments, > 26 elements are represented, making turtles roughly half as abundant as pig at a conservative estimate. At well over 100 kilos live weight (for the green turtle, *Chelonia mydas*), sea turtles, as well as their eggs, might have served as a significant source of protein in midsummer, their nesting season.

More than 20,000 individual molluscs by MNI, amounting to some 55 species, were identified (Ridout 1982). As at Akrotiri and Aceramic Neolithic coastal sites, limpets (*Patella*) and topshells (*Monodonta*) dominated the assemblage: 56% and 20% of MNI (Ridout 1982, 93). As at Mylouthkia, Ridout noted the small size of the limpets, which averaged 26 mm, and suggested the possibility of over-exploitation, though no change over time is identifiable, and the size range is roughly comparable with specimens from the Cretan Bronze Age site of Myrtos (Ridout 1982, 93-95). Other species included *Trunculariopsis trunculus*, *Arcularia gibbosula*, *Tonna galea*, and *Charonia nodifera*; some examples of these and of other species were pierced, and occurred in groups which suggest their use as personal ornaments (Ridout 1982, 93-94). No shell middens were found at the site, and most of the limpets and topshells were found in fills associated with structures (Ridout 1982, 93). Shell middens at the site might, of course, have eroded into the sea, though it seems equally possible that shells were simply thrown into the sea. In addition to the marine molluscs, numerous land snails are represented; as usual it is difficult to determine which are intrusive

(Ridout 1982, 94)

Peltenburg argued that “the subsistence economy of the inhabitants was wholly integrated with the local environment,” based on the absence of evidence for resources occurring outside the site catchment (Peltenburg 1982a, 98). The chert used at Vrysi has not been sourced, and may be local, but since chert at Aceramic sites seems likely to have derived from a wide range of sources (Stewart 2004), and since the Vrysi obsidian cannot be locally derived, it seems reasonable to assume that obtaining these resources required some degree of mobility on the part of the Vrysi villagers. During such mobility they may have engaged in some degree of environmental monitoring, exchanged information about resources with members of other groups, and exploited resources other than those normally available on the narrow coastal plain in the immediate vicinity of the site.

Peltenburg infers a slightly less arid environment in the vicinity of Vrysi in the Ceramic Neolithic than the present day, based on the greater variety of trees represented in the charcoal sample (1982). Present day precipitation data for Kyrenia accord well with Held's estimate in indicating average annual rainfall of about 500 mm., subject to the interannual variation normal in Cyprus (Christodolou 1959; Br. Admiralty 1926). As Peltenburg points out, however, much of this precipitation occurs in the winter, and runs directly into the steep wadis which traverse the narrow coastal plain, thence directly into the sea (Peltenburg 1982a, 12). The closest of these is about 100 m from the site (Peltenburg 1982a, 9). Additionally, inhabitants would have been able to draw water from a perennial spring, though the area west of Kyrenia today has

many more of these springs than are found in the immediate vicinity of Vrysi and Troulli (Peltenburg 1982a, 9).

Based on the botanical samples recovered, Kyllö (1982, 90) suggests the presence of cleavers, gromwell, fumitory, pheasants eye, and poppies, while Ridout cited the presence of xerophilous land snails as evidence that the landscape was “dry open country” (1982, 94). *Truncatella sub-cylindrica*, freshwater molluscs, were found primarily in floor deposits and may have been introduced to the site along with reeds used as floor coverings (Ridout 1982, 94).

Modern land use include dry-farmed carobs and olives (Held 1992, 88). Interestingly, analysis of modern land-use found that most of the most fertile and high-valued soils deemed suitable for intensive cultivation were more than 2 km west of the site, closer to the modern village of Ayios Epiktitos. Arbitrary 1 km to 3 km diameter circles contained a much higher proportion of land described as “arable with tree crops,” scattered olives and carobs, while many of the areas east of the site, in the direction of Vrysi, were more marginal land used for grazing (Legge 1982a, 15). In 1972, under a traditional regime of dry agriculture which made use of animal plows, crop yields were in the range of 950 kg/ha for both wheat and barley, at the high end of Eastern Mediterranean data for dry agriculture, on about 100-150 kg sown seed/ha (Legge 1982a, 16). Almost everyone kept a few goats, and shepherds and goatherds kept substantial flocks in small upland valleys, well inland (Legge 1982a, 18-19). In short, it would appear that arable land and grazing were more than sufficient to support the number of people likely to have lived at a site which might at its greatest

extent have been 0.1 ha.

Evidence for storage at Vrysi is ambiguous. The structures at Vrysi may have contained lofts either for sleeping or storage, their presence attested by recesses for post-holes in surviving walls (Peltenburg 1982a, Peltenburg 2003). The design and position of these was not universal, however, in contrast to other features of the “Late Neolithic House,” which display a certain regularity across time and space: central hearths and low benches against the walls that may have been used as craft production areas. Peltenburg noted the apparent absence of storage pits (1982, 99), concluding that unless storage was in perishable containers, “little effort was made to produce crops beyond the immediate requirements of the community.” This seems a bold inference from absence of evidence, especially at a site much of which has fallen into the sea.

There is some evidence from the ceramic assemblage for an increasing concern with storage, as the sizes of the largest closed shapes increase over time. Small bowls, many of them spouted, along with handleless jugs or flasks, are present in all periods. Despite the introduction of pottery, stone bowls continued to be manufactured and used (Peltenburg 1982a). There is no evidence for the production of different goods in different structures (Peltenburg 1982a, 101), or of strong spatial differentiation in the distribution of ceramics which would suggest that some households used more pottery or different sorts of pottery.

However, some intrasite differences existed in architecture and other categories of material evidence. As mentioned above, the site is physically separated into two

sectors by a wall, a separation which, along with an apparent concentration of ritual material in larger structures in the North sector, has been argued to reflect asymmetric social relations between two groups at Vrysi (Peltenburg 1993). Structures in the South sector may have been erected at the same time, and it is possible these people were newcomers, but the distinction between North and South sectors persisted throughout the duration of occupation (Peltenburg 1982a, 105). A wall and ditch in the south (landward) sector have been taken as evidence of fortification (Peltenburg 1975, 1982a, 1993, 2003).

KLEPINI-TROULLI

Klepini Troulli is another coastal site, about 4 km east of Vrysi. It is situated on one of the many promontories which are a feature of the north coast, on the slopes of a hill topped by an eroding rock formation which, as Dikaios suggested, may have been more prominent in prehistory (Dikaios 1962, 63). The site was excavated by Dikaios (Dikaios 1962) and much of the artifactual material subsequently reexamined by Peltenburg (Peltenburg 1978). It represents another site with Aceramic and Ceramic Neolithic components (about which more below). Two absolute dates for Troulli were obtained from TL on sherds from surface survey and, since they place the site in the second millennium BC, are likely to be totally erroneous (Clarke 2007a, 19-20 and Figure 2.3).

Excavation of the Ceramic Neolithic levels at Troulli revealed several structures, some apparently adjacent monocellular structures, though their walls

touched, and one unusual extended structure (Dikaios 1962, Fig. 33). Inside this large structure were three central querns and a “bin” feature made of upright stelai, the joins between them carefully filled (Peltenburg 1978, 26). No botanical remains were recovered from the “bin.”

Indeed, little to no information is available regarding the plant and animal remains from Troulli, which is a great pity, since it would have been useful to compare Aceramic and Ceramic Neolithic botanical and faunal assemblages from the same site, and Ceramic Neolithic assemblages from Troulli and Vrysi, in such close proximity and relatively similar coastal environments. Unlike Vrysi, Troulli is located almost 300 m. from the closest modern spring (Peltenburg 1978)—though it should be noted that for premodern people living in a semi-arid environment, this does not necessarily represent a long distance to fetch water.

Troulli's contemporaneity with and spatial proximity to Vrysi, and the apparent defensive posture of the two sites, raises the question of competition between the sites for resources (Clarke 2001). However, this seems unlikely for several reasons. First is the small size and correspondingly small populations of the two sites. Based on Legge's observations, the land between them is less productive than the richer soils west of Vrysi (Legge 1982a), and might therefore have been used for shared grazing and perhaps as hunting territory. Additionally, in practice the two sites' catchments are likely to have been irregularly shaped, perhaps extending far inland into the steep Kyrenia range. Close affinal and kinship ties may have acted to ease such conflicts as did arise over resources (Clarke 2001). A similar situation, though with apparently

more ephemeral sites, appears to have obtained in the Vasilikos region.

THE VASILIKOS VALLEY

The nature of the Ceramic Neolithic occupation in the Vasilikos Valley is enigmatic. There are no securely known village sites like those at Vrysi or Nysia (below). Rather, there appear to be a cluster of sites in the lower Vasilikos valley, some of which may have been occupied with varying degrees of intensity, others of which may have served special functions. These are Tenta itself, Kalavastos *Kokkinoyia*, and Kalavastos *Pamboules* or *Bamboules*. Thanks to the work of the VVP these sites can be contextualized within the natural and human landscape of the Vasilikos valley.

Nowhere at Tenta were Neolithic ceramics found stratified above Aceramic levels. Work by David Baird, unpublished but used by the excavators, has redated much of the ceramic material from Tenta previously believed to be Late Neolithic to the Early Chalcolithic. Only those sherds from context O 16 B are now considered to belong to the Ceramic Neolithic (Clarke and Todd 1993, 17, note 17). Kalavastos *Kokkinoyia* is a complex of pits less than 1 km SSW of Ayious and some 400 m SE of Pamboules (Clarke 2004). Strikingly, virtually no animal bone has been recovered from the site, suggesting this site may have had some special purpose unconnected with ordinary habitation. Kalavastos *Pamboules* is situated on a low plateau east of the Vasilikos, 0.5 km NW of Kokkinoyia and < 3 km SE of Tenta. The site was recorded by Dikaios (1962) who excavated pits which according to his field notebooks he

interpreted as semisubterranean houses (Clarke and Todd 2004, 15). Most of the material he found he assigned to the Chalcolithic, but his “Pit VIII” also contained Ceramic Neolithic material. Pamboules was later recorded and surveyed by the VVP (Clarke and Todd 1993, Todd 2004) and excavated by Joanne Clarke (Clarke 2004, Clarke et al. 2007). Like Dikaios, they found that ceramic material was predominantly Late Chalcolithic, and less than 1% Late Neolithic. Perhaps, like Kokkinoyia, Pamboules had a particular function (Clarke et al. 2007, 59-63).

The VVP identified more than 15 Ceramic Neolithic sites in the Vasilikos Valley, some almost certainly representing permanent settlements. I have argued (above, Chapter 2) generally against taking the absence of a surface archaeological record in particular localities as conclusive evidence for the absence of settlement or activity. This principle applies with more than ordinary force in those parts of the Vasilikos Valley which have been subject to sedimentary deposition over the course of the last few millennia. There may well be numerous Ceramic Neolithic sites in the Vasilikos floodplain, buried beneath meters of sediment (see remarks by Gomez in Todd 2004, 7-10).

That said, it is possible to make some observations about the patterns in the sites recorded by the VVP. Ceramic sites are more widespread than in the Aceramic and are distributed across the central and southern Vasilikos valley, with many in the hilly zone west of the Vasilikos river, and the upper (northern) reaches of the valley. It is often impossible from surface material to determine whether many of these sites represent permanent or seasonal settlements or some more ephemeral activity.

A good example is Kalavasos *Angastromeni*, on the top of a high hill west of Kalavasos village, therefore just into the western hilly zone, and somewhat more than 2 km NNW of Tenta (Todd 1988, 134; Todd 2004, 35). The size of the site was estimated by the VVP at 1.125 ha, exclusive of material eroding down the N and W slopes (Todd 2004, 36). Todd noted that the site commands a view of much of the river valley as well as the coast from Zygi to Vasiliko, a vista which gives sight lines to all the other known Ceramic Neolithic sites in the lower Vasilikos valley (Todd 2004, 36). About 2 km south of Kalavasos *Angastromeni* and about 0.5 km W of Tenta is Kalavasos *Argakia East*, a possible settlement of about 0.175 ha (Todd 2004, 38). Todd notes its intervisibility with Ipsopamboulos and Tokhni *Latomaes* (Todd 2004, 38). In turn, about 400 m west of *Argakia East* lies Kalavasos *Kafkalia VI*, with localized scatter of Neolithic pottery (Todd 2004, 52). Activity still further west in this western hilly zone is represented by Kalavasos-Zouloftidhes, about 1.5 km W of *Argakia East*.

Not inconsiderable quantities of Ceramic Neolithic material have also been found in the northern Vasilikos valley, in the vicinity of the dam (Todd 2004, 83). Todd suggests that Aceramic Ora *Klitari* was abandoned in favor of “more strategically located” hilltop site of Kalavasos *Markotis*, 700 m to the west (2004, 83) and about 3 km north of *Angastromeni*. While several periods are represented, the Ceramic Neolithic component is largely confined to the top of the hill (Todd 2004, 82). Nearby Kalavasos *Mazeri*, about 600 m south of *Markotis* (Todd 2004, 83), Kalavasos *Spilios* (Todd 2004, 101-2), and Kalavasos *Yirtomylos* less than 1 km south

of Mazeri (Todd 2004, 111) also attest activity in the northern part of the valley. None of these sites are particularly large.

An apparent preference for hilltops and steep slopes overlooking the valley might be an artifact of the apparent absence of deeply buried flood plain sites. Lowland valley sites like Tenta, Kokkinoyia, and Pamboules, on the east side of the river and 1.5 km SW of Tenta, in an area where the Vasilikos valley broadens before emerging onto the narrow coastal plain, are discussed above, while Mari *Mesovouni*, mentioned above, may have had a Ceramic as well as an Aceramic Neolithic component (Todd 2004, 120). Also in the southern Vasilikos, Mari *Palaimbela* was apparently a small settlement (0.06 ha) cut into by Archaic (ca. 7th-5th c. BCE) tombs. Interestingly, ceramics include Cb, Pcb, RW, RMP, CW (Todd 2004, 122-3). Dikaios (1953, 319) mentioned semi-subterranean structures similar to features he recorded at Kokkinoyia and Pamboules (above, Clarke and Todd 1993).

The terraces and hills on the East side of the valley were apparently not as heavily frequented as the western and northern zones, though there is a substantial scatter of Ceramic Neolithic pottery at Tokhni *Latomaes*, on the west slope of a hill overlooking the valley, intervisible with Angastromeni (Todd 2004, 134). Little or no survey has been done in the area of the gypsum quarry, while more survey could be done in the northern Vasilikos valley, below the dam.

While detailed inferences about these sites' use of local resources are not possible from the VVP data, a few general statements are possible. These sites are not necessarily adjacent to either water sources or prime agricultural land. While there are

many small, steep streams and creeks (Greek: *argakia*), which feed into the Vasilikos, many of these will have been seasonal even under a wetter climate regime and will not have constituted reliable, year-round sources of water.

The Vasilikos valley in its present condition represents a highly eroded landscape. Tons of sediment have been washed from hills and ridges into the river over the course of the human occupation of the valley (Gomez, Hansen and Wagstaff 2004). Upland areas west of the Vasilikos which now are limestone hosting thin maquis vegetation might have had deeper soils supporting woodland and fields. Unfortunately the reconstruction of very local vegetation regimes in prehistory without palynological and anthracological data to supplement geomorphology is an exercise in speculation.

Clarke has plausibly interpreted Neolithic site clusters as communities distributed across the landscape (2001). Daily interaction among them may have been fostered by drawing water, moving domestic animals, commuting to fields if these were distributed outside the immediate area of the settlement. At the locality Kalavassos *Ayios Yioryios-Kafkalla* (Todd 2004, 42), tombs with associated Ceramic Neolithic pottery must belong either to an otherwise undocumented settlement or constitute extramural burial, not generally considered a common practice in the Ceramic Neolithic.

Kent Flannery and others recognized in the early 1970's that a fixation on the village aspect of early village societies necessarily gave short shrift to those sites which were not villages and those activities that took place outside settlements

(Flannery 1976, 5-8, 131-6). They nonetheless were explicitly concerned with explaining causal relationships between social changes and widespread change in residential patterns, a major problem now being attacked from new angles (Watkins 2004a). Interactions outside built areas, in fields and “wild” areas are often as important in villagers' relations with one another as what happens in villages (Wolf 1968; Fox 2007; Robb 2007; Santasombat 2008; Berger 1979). However, the archaeological record does not always lend itself to the study of these interactions, except insofar as they produce changes in the landscape itself, such as terraces or deforestation; or result in the deposition of archaeological material where they took place—terraces, lithic scatters—or changes in the deposition of such material in other contexts, e.g. bones of hunted game at settlements, or ceramic traditions plausibly interpreted as reflecting the materialization of identities (Clarke 2001). It seems possible that only a small number of the Ceramic Neolithic sites in the Vasilikos valley were villages, in the sense of permanent, year-round settlements. Todd and Clarke suggested that Pamboules and Kokkinoyia “represent the shifting spatial organization of one site” (1993, 26), perhaps on a seasonal basis. Without significantly better data about the economic basis of the Ceramic Neolithic occupation in the Vasilikos valley, it would be futile to speculate about local human ecology.

KISSONERGA-MOSPILIA

The site of Kissonerga-Mosphilia in the Ktima lowlands of the western coastal plain in Paphos district (map, Figure 9), is best known as one of the most important

Chalcolithic sites on Cyprus (Peltenburg 1982a). However, material at the site dates from the Late Neolithic through Early Bronze Age; with both Aceramic and Ceramic Neolithic activity, if not occupation, attested (Peltenburg 1998, 22-3). Ceramic Neolithic activity is indicated by deposits, some sealed, of typologically early Combed Ware and Late Neolithic Broad Line variant of Red-on-White (RW) ware (Peltenburg 1990, Peltenburg 1998, 22-3). Structures or further evidence of Late Neolithic activities may have eroded (Peltenburg 1998, 23). While there is insufficient evidence to assess the nature of stress at the site, or the strategies which may have been used to offset such stresses, it is worth mentioning, in light of statements such as that by Steel (2004, 67) that “the ceramic Neolithic has not been identified in the western part of the island.”

Data from surveys in the long river valleys of southwest Cyprus, such as the Ezousas, Dhiarizos, and Xeropotamos, and the smaller river valleys south of Chrysokhou Bay in northwest Cyprus (Rupp et al. 1993; Maliszewski 2007) also indicate a Ceramic Neolithic presence. The Western Cyprus project documented a chain of Late Ceramic Neolithic sites up the Dhiarizos valley, all situated close to (< 1 km) the river (Rupp et al. 1993, Fig. 5). However, since few upland areas were covered by the Western Cyprus Project, that pattern remains to be substantiated. The three Late Ceramic Neolithic sites in the Dhiarizos valley are Phasoula *Mavroloizos*, Prastio *Kokkinolaona*, and Kithasi *Plevra*, south to north.

Survey in the Potamos Stavros tis Psokas has documented four Late Neolithic sites, identified by Maliszewski as “settlements,” in the Stavros tis Psokas valley (cf.

Baird 1987). Some of these had earlier been dated to the Chalcolithic, but analysis of the Red-on-White, Painted and Combed, and Combed wares places them securely in the Ceramic Neolithic (Maliszewski 1993, 90). These form a fairly tight cluster, all within 5 km of one another. Another likely Late Neolithic site in the region is Drousia Ayios Sergios, about 4 km west of the Chrysokhou river drainage. Previous survey of this river valley (Adovasio et al. 1975) used a problematic ceramic chronology which calls the dating of identified sites into question. While the sites of the Stavros tis Psokkas cluster do not appear to be anywhere near as large or as impressive Kantou or Paralimni (below), they are significant for several reasons, and clearly deserve further investigation.

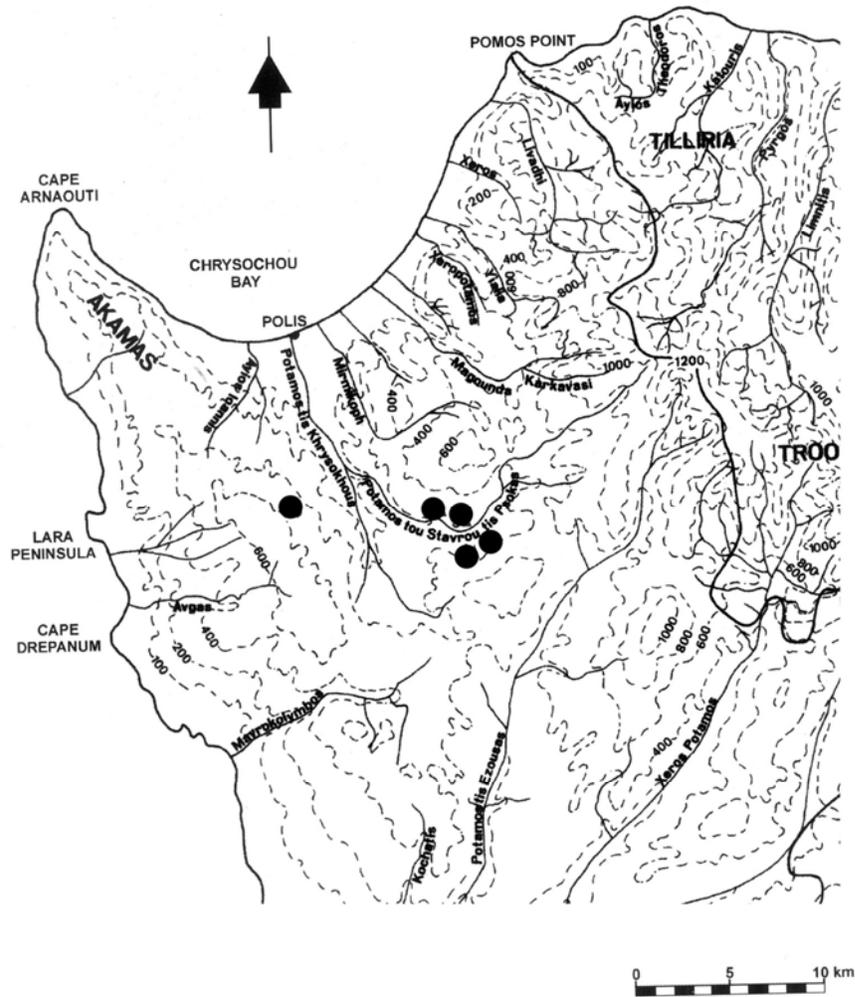


Figure 10. Ceramic Neolithic sites in the Stavros tis Psokas and Khrysokhou drainages in Western Cyprus (adapted from Maliszewski 2007, Fig. 3)

KANTOU-KOUPHOVOUNOS

The site of Kantou *Kouphovounos* lies on a low (250 m) hill in Limassol

District (see map, Figure 10), not far from Sotira. It was excavated between 1992 and 1999 by Eleni Mantzourani. Based on electromagnetic resistivity, the site's extent may be 20,500 m², making it by far the largest Ceramic Neolithic site on Cyprus (Mantzourani 2003). Not all of this area need have been covered with structures, though they appear to have been densely packed in at least the Central Area (Fig. 11, below).



Figure 11. Aerial view of Kantou Kouphovounos, Central Area (adapted from Mantzourani 2003, Fig. 2)

There are only two radiocarbon determinations from Kantou. The first apparently dates one of the earliest phases of the site to 5350-5050 cal BC (Mantzourani 2003, 98; Clarke 2007a, 19)—cutting dramatically into the gap between the Aceramic and Ceramic Neolithic. A second radiocarbon determination on charcoal

from a stratigraphically later phase gave a date of 4460-4420 cal BC (Mantzourani 2003, 98), more in line with traditional dates for the Ceramic Neolithic (Clarke 2007a, 17-20). This is not to say that the site was continuously inhabited, but given the phasing, it appears that it was subject to long periods of year-round occupation for the better part of a millennium. Excavations have revealed 39 monocellular structures, most roughly rectilinear with rounded corners, belonging to several different phases. Particularly noteworthy is an early, large structure, House 3, which has an interior area of some 56 m². Later buildings built atop it were not so large (Mantzourani 2003).

Preservation of botanical remains at Kantou is reasonably good, according to the excavators; they have been thoroughly studied by Evi Margaritis, but I have been unable to consult her final report. Both emmer and einkorn wheat are present: einkorn seems to dominate. Other crops included barley (*Hordeum vulgare*), domesticated lentils (*Lens culinaris*), and pea (*Pisum* sp.). Vetches (*Vicia*) and mallow (*Malva*) are also attested (Mantzourani 2003, 97). Here too, there is evidence of grape seeds identified as wild (*Vitis* sp.). Data for the relative representation of these different cultigens and any temporal or spatial variation in their distribution on site have not yet been published.

Preservation of the faunal assemblage, in contrast to the botanical remains, was poor, such that hardly any of it could be identified to species (Mantzourani 2003, 97). Intriguingly, the assemblage thus far seems to consist primarily of caprines, though pig and deer are also represented (Karali 2002, 467). Kantou was apparently exploiting marine resources as well. Of the mollusca, *Murex trunculus* were most abundant;

represented in lesser proportions were *Ostrea edulis*, *Cardium*, and *Patella* sp. (Karali 1996). As at Vrysi, Triton shells were present. At Kantou, these appear to have been deposited along with groundstone artifacts, in the fill below house floors, perhaps as a sort of foundation deposit (Mantzourani 2003, 98).

No storage features have been identified in the preliminary publications. Thus far, two excavated burials have been published, both intramural; one primary and one secondary, neither very informative regarding the existence of nutrition- or stress-related pathologies (Mantzourani 1996). Kantou is clearly one of the most important sites for understanding the transition from the Aceramic to Ceramic Neolithic, and from the Ceramic to the Early Chalcolithic. One can only hope that more information about the excavations will be forthcoming.

PARALIMNI-NYSIA

Paralimni *Nysia* (or *Nissia*) is located on a low hill hard by the Potamos tou Lombarti river, in Famagusta district, close to the modern coast. It was identified and excavated by Pavlos Flourentzos for the Department of Antiquities. The extent of the site has been estimated at 3250 m² (Flourentzos 2003, 74), or about 0.325 hectares. The settlement was apparently surrounded by a substantial wall inside which structures have been argued to form a spiral; there are also some structures outside the wall. The structures are for the most part rectilinear with rounded corners; some of the structures share a common wall. Unusually, House 22 has a pebble floor and a central hearth of 1 m in diameter, of reddish clay (Flourentzos 2003). Pebble floors also

appear in other structures (Flourentzos 2003).

Flotation of soil from Nysia is said to have produced no seeds whatever (Flourentzos 2003; 2008, 97). The excavators were more fortunate with the fauna, which have been studied by Paul Croft. Percentages by NISP are reproduced in Table 2 below. Deer probably furnished somewhere in the neighborhood of three times the meat per animal as caprines. Even if subject to differential recovery (Croft 1998), they were still by far the most important animal resource at the site, possibly accounting for 90% of meat consumed (Croft 2008, 102). Croft points out that these very high percentages of deer are in keeping not only with early Ceramic Neolithic sites like Dhali *Agridhi*, but with nearby Chalcolithic sites in the south of the island like Kalavastos *Pamboules* and Kalavastos *Ayiou*, which are discussed in the next chapter (Croft 2008, 108). The mortality profile for deer, based on epiphysial fusion, is interesting: 1.7% died as infants (<1 year), 18% as juveniles, only 3% as subadults, and 77% as adults (Croft 2008, 102). This likely reflects careful management of deer population for meat; probably hunters took mostly males, though the sample size is too small for sexual dimorphism to be evident.

The caprine remains include 19 elements belonging to goats and 16 to sheep. The goat horn cores are of the “scimitar shaped” variety, which is prevalent on Cyprus until the introduction of new breeds in the Early Bronze Age (Croft 2008, 103; Croft 2006, 270). Here also epiphysial fusion suggest a strong emphasis on meat production, as expected. 11% of caprines died as infants, almost none as juveniles (18-28 months) roughly 29% in the subadult phase, and the remaining 60% as adults, older than 2.5 to

3.5 years (Croft 2008, 104).

There is only a small number of pig remains. These suggest that all age categories were represented; here there may have been increased culling of younger animals, given large litters and rapid weight gain. Dogs were apparently mid-sized, and chewed on much of the assemblage (Croft 2008, 105). Fish are poorly represented for a coastal site (Croft 2008, Reese 2008). The larger shark-ray vertebrae are perforated and may have been worn as ornaments (Reese 2008, 147-8). Croft contrasts the 20 fragments from larger fish actually recovered in excavation with many times that number of remains of smaller fish from the very limited flotation samples at Nissia (2008, 105). Fish and avifauna are both very likely to have been subject to differential recovery (cf. Croft 1998, 208).

Careful attention has been paid to the molluscs (Flourentzos 1997, Reese 2008). The most common in terms of MNI are:

Patella 491 = 53.7%

Spondylus 97 = 10.6%

Monodonta 57 = 6.2%

Charonia 58 = 6.3%

Glycymeris 42 = 4.6%

Tonna galea 40 = 4.4%

Murex 48 = 5.2%

total=915

*data are taken from Reese 2008, 119.

The importance of *Patella* is a familiar feature of Neolithic shell assemblages, as at Aetokremnos, Mylouthkia, Vrysi, and Cap Andreas. The *Mondodonta* were apparently less important at Nysia. The situation is strikingly different from that at Kantou, where *Murex* dominate. It is uncertain whether this reflects a real difference in procurement or depositional factors, since shellfish might have been consumed in large numbers on the beach. Of the species less well represented, *Tonna galea* will have made a more significant contribution to diet at Nissia than other species because of their large size. At other Early Prehistoric sites, conch or triton shells (*Charonia*) are thought to have some ritual function based on their appearance in “foundation deposits.” At Nissia they were sometimes made into vessels (Reese 2008, 120).
Whelks, dove shells, cockles, and cuttlefish, common food species at some other sites, are represented in very low numbers. The small number of land snails recovered (n=8) are thought to be intrusive (Reese 2008, 147).

Evidence for the storage, processing, presentation and consumption of surplus suggests that while for the most part storage and processing operated at the household level and often took place indoors. House 22, one of the largest structures on site and distinguished by other features such as a pebble floor, larger than usual quantities of chipped stone and the presence of tools and/or weapons (axes and mace head) apparently had an interior hearth (Flourentzos 2008, 16). However, a limited amount

of outdoor cooking and consumption, as in the area adjacent to House 28 outside the settlement wall (Flourentzos 2008, 21), might have involved either single households or groups of households, but in any case will have been more visible to other community members. Normally the fact that a third of fish bones from the site came from a single structure (House 20) would suggest specialization in fishing on the part of its residents, but the extremely limited nature of the assemblage, 20 fish bones in all, makes any such conclusion problematic.

Though limited information is available from the catalog presented in the final site publication (Flourentzos 2008), it would appear that most storage was probably in pits, or in other facilities (baskets, chests, granaries) which have not survived. The published ceramics represent a rather restricted range of shapes, many of which would have served for the presentation of food, though few are obvious candidates for storage on any scale. Flourentzos has argued that a feature within House 22, with the pebbled floor and red earth hearth, may have served as the base for a pithos (storage jar) (Flourentzos 2008, 74). The ceramics from the site included sherds of at least one Dark-faced Burnished pithos (Flourentzos 2008, 52). By and large, however, the published material consists of spouted basins, jugs and flasks, few bowls, and a surprising number of miniature vessels (Flourentzos 2008, 90-1). Animals are depicted on painted ceramics, unknown elsewhere in the corpus of Ceramic Neolithic pottery (Flourentzis 2008, 97). As at Vrysi, stone vessels continued to be important: stone basins and spouted basins were apparently used alongside ceramics (Flourentzos 2008, 85-6). These were more often in calcarenite than in andesite, the hard stone which had

been used in the “Khirokitean” phase of the Late Aceramic Neolithic for the production of sophisticated stone vessels, but which at Paralimni tended to be used for artifacts such as querns and pestles.

Overall, the ground stone assemblage reflects a range of tasks including woodworking and processing of cereals and other plant foods. Querns were often found inside structures, sometimes in groups, as in Houses 30 and 14, which apparently had a specialized installation that the excavator has suggested served for the production of salt (Flourentzos 2008, 10). Typologically, most of the querns at Nissia are ellipsoid querns rather than saddle querns; in contrast, Vrysi has none of these ellipsoid querns (Flourentzos 2008, 79). Additionally, three surprising features of the assemblage stand out. First is the presence of a number of stone weights, called “loom” weights but thought by the excavator to be net weights, for which there are no parallels at Sotira or Vrysi (Flourentzos 2008, 89). Second are the numerous examples of stone artifacts interpreted as sling bullets (Flourentzos 2008) and of mace heads (Flourentzos 2008, 85). Finally, An extraordinary number of stone “idols” and figurines have been recovered, including figurines interpreted as fish and turtles (House 32), an octopus, birds, quadrupeds, and anthropomorphic heads and figurines, some of which are similar to Cycladic types (Flourentzos 2008). Figurines are also found in terracotta: a pregnant(?) woman, a bovine foot, and a “table of offerings” (Flourentzos 2008, 92-3). Flourentzos argues that these “prove without a doubt that the coroplastic art originated in the Late Neolithic period” ; there are, however, clay figurines from Cypro-PPNA Ayia Varvara *Asprokremnos* (McCartney, pers. comm.). It

is possible that the production of such figurines was a purely local tradition, since they are not known anywhere else on Cyprus in such numbers.

Carole McCartney has conducted a use-wear study on glossed tools from Nysia (2008). She argues that glossed blades were not only used for harvesting, but in a variety of other applications. Indeed, most blade production may have been for use in composite threshing tool such as a *dhoukani* sled, while working with reeds was clearly also an important activity (McCartney 2008, 64-7). Obviously, this does not mean that the site relied any less heavily on cereals, nor is the reported absence of botanicals likely to be very significant.

Evidence for external relations comes from the defensive posture of the settlement, ceramic styles, and raw material procurement. Flourentzos characterizes the settlement wall as “the most complete defensive wall hitherto excavated at a Cypriot Neolithic settlement,” but hypothesizes that it had become obsolete at the time the extramural houses were constructed (2008, 20), while it is possible to imagine that the artifacts identified as “sling stones” and “mace heads” were used in more benign applications. Points do not figure among the chipped stone tool types (McCartney 2008). No human skeletal or mortuary evidence has been published in which it would be possible to look for signs of violent conflict.

Ceramic style in the Ceramic Neolithic is a whole area of study, has been addressed by other workers (Clarke 2001, 2007). The wares at Paralimni include Combed Ware, Red on White, Red on White and Combed treatment of the same vessel, Red Lustrous, and Buff Ware, of which Red on White is the most common

(Flourentzos 2008, 50-53). In gross terms, these wares confirm that Paralimni participated in a very loose ceramic koine with other Ceramic Neolithic sites, one in which different wares may have been in use at different times in different places. A picrolite bead provides further evidence of external contact with other Ceramic Neolithic settlements (Flourentzos 2008, 88). The chipped stone assemblage reflects roughly equal use of Lefkara basal and Lefkara translucent cherts, in addition to other types, all of which are readily available near Paralimni (McCartney 2008, 58). No obsidian was reported. Features of the chaîne opératoire such as bidirectional core reduction and glossed crescents hark back to the Aceramic Neolithic (McCartney 2008, 62; 2005, 204-206). This evidence of direct connections in craft production is especially significant since Ceramic Neolithic people have often been seen as invaders, interlopers or re-colonizers. Though calcarenite rather than andesite was used for vessels at Paralimni, the continued use of andesite for the production of sculpture might represent an aspect of cultural continuity with the Aceramic.

KISSONERGA-MOSPHEILIA

At Kissonerga (see above, Chapter 3, for its location and surround) there is exceedingly limited evidence for a Late Neolithic occupation preceding the important Chalcolithic phases at the site (Peltenburg 1998). While the deposits containing Neolithic material do not provide good evidence for subsistence practice at the site, these early traces of activity in the Ktima lowlands near the Aceramic wells at Mylouthkia and at what would later become a major locus of Chalcolithic settlement

suggest the continuing attractiveness of the narrow coastal plain of southwestern Cyprus.

DISCUSSION

The nature of the available evidence creates real problems both for identifying sources of subsistence stress, and characterizing variation and change in subsistence strategies and practice. Wasse argues (2007, 49) that the last traces of the early Holocene Humid phase had disappeared ca. 7 ka B.P., before the earliest radiocarbon dates for Vrysi, Philia-Drakos, and at the tail end of the range for the earliest radiocarbon determination from Kantou. Furthermore, he suggests that at this point Cyprus might have seen the beginning of pronounced interannual variability in precipitation noted by modern observers. Unlike Wasse, I am unwilling to use the charcoal evidence from Khirokitia to push this trend earlier, into the Khirokitean phase of the Aceramic Neolithic, since this evidence corresponds dubiously with pollen cores from the site and both may reflect local, rather than regional, environmental change (See Chapter 3).

The Ceramic Neolithic, therefore, may have necessitated the development of more conservative buffering strategies and practices. However, there is very scanty evidence for these (cf. Croft 2008, 106-7). The same cereal crops used in the Aceramic were used to support the village societies of the Ceramic Neolithic; both emmer and einkorn wheat being grown alongside barley at all sites for which there is evidence. It

seems likely that the sowing of maslins continued, but this is impossible to check without better botanical assemblages. Wild plant resources including wild lentils were apparently consumed at Dhali-Agridhi, though pulses at other sites may have been domesticated.

All this might create the impression of agricultural conservatism in the Ceramic Neolithic. However, given ethnohistoric evidence for change in Mediterranean agriculture in the premodern period, not only as a result of state-level imperatives but as individual farmers' responses to conditions and preparations for the future (Halstead 1987), it seems likely that we are simply missing most of the fine-grained evidence for changes in relative representation of different cereals through time and in different locations. To some extent this can be remedied with careful attention to microstratigraphy and by flotation on an ambitious scale.

There is some evidence to suggest that agricultural strategies were shifting over the course of the Ceramic Neolithic. While we cannot rule out the possibility that they were present but not exploited in the Aceramic Neolithic, it appears wild grapes may have been introduced to Cyprus through human agency at the beginning of the Ceramic Neolithic. While in many regions the sites of Aceramic villages were reoccupied in the Ceramic Neolithic, the Vasilikos valley shows that new areas were also brought under cultivation, areas with different soil types and climax vegetation.

In animal economies, there is a strong degree of variation among Ceramic Neolithic sites. In effect, sites for which there are faunal data can be divided into two clusters: those sites at which deer account for 70-80% of the faunal assemblage by

NISP (Philia- Drakos, Dhali-Agridhi, Paralimni, Sotira), and those at which deer are less than 50% of the faunal assemblage (Vrysi, perhaps Kantou).

Wasse argued (2007) that sheep herding at Late Aceramic Neolithic Khirokitia represented a response to regional climate trends (aridification) and a locally degraded landscape. If we accept that paleoclimate data reflect increasing aridification from the 5th millennium BCE, we might expect herding to have been the primary strategy during the Ceramic Neolithic as well. However, at least some long-lived sites reflect a strong specialization in deer.

One possible explanation is a “re-colonization” of the island, in which settlers took advantage of a deer population that had rebounded during a period in which they experienced dramatically lower losses from human predation. If this were the case, we might see earlier sites relying on deer, later ones more on caprines, as aridification continued, areas around settlements became denuded of trees and turned into the sorts of open grasslands favoring caprines, and as human population growth reduced the deer population. However, this scenario does not fit well with the available data. Vrysi is early, but caprines are nearly as well represented in terms of NISP as deer, while Philia-Drakos relies heavily on deer, as does Sotira, a little later. The limited environmental data suggest sites were founded in open country; they do not tend to suggest (although they cannot rule out) deforestation in the vicinity of settlements. Additionally, the apparent human abandonment of the island is rendered problematic by evidence that the Aceramic Neolithic populations retained elements of much earlier chipped stone industries (McCartney 2008, Clarke et al. 2007), by the early dates from

Dhali *Agridhi* and Kantou, and by the fact that Aceramic sites like Tenta were reoccupied (perhaps after an interval of high mobility, low occupation intensity, and only short term seasonal visitation).

In effect the sample is simply too small to test competing explanations for the varying emphasis on hunting and herding. Most useful would be to obtain more faunal data from already excavated sites, and to sample some of those known from survey, like those in the Stavros tis Psokas river drainage or the upper Vasilikos valley. Given the continued economic importance of deer in Early Prehistoric of Cyprus, this question deserves further investigation.

Turning to domestic livestock, unlike the situation at Late Aceramic Khirokitia, goats rather than sheep predominated at Vrysi: Legge's and Peltenburg's explanation that they better suit the rough browse and rough terrain is probably a good one. Herding clearly was also practiced at other sites; the social implications of mixed herding/hunting economies deserve more attention. As in the Aceramic, pigs were a consistent feature of village economies, as quick weight-gainers and a valuable source of meat throughout the year. They may have been kept in pens adjacent to the settlement, or turned loose to fend for themselves in nearby mixed woodlands of oak and lentisk.

There is thus far a lack of evidence for any strong focus on marine resources in the Ceramic Neolithic, though molluscs were well-represented at Paralimni. It is hard to believe the inhabitants of that site, or of Vrysi and Troulli, did not exploit at least the coastal fish species at hand; they may simply have done so at coastal locations

now inundated by sea level change. In human behavioral ecology, exploitation of a “broad spectrum” of wild resources and small game often represents a lower total return on energy invested than a focus on a limited range of productive foods and higher-calorie packages, thus the broad spectrum diet is a transition potential sign of resource stress. This is not incompatible with the fact that exploitation of a variety of resources sometimes reflects food preferences: if these preferences are extremely energetically inefficient they may incur a fitness cost, but otherwise contribute to getting enough of different kinds of nutrients, including vitamins and crucial lipids (Kelly 1995, Speth 1991).

There are few positive inferences to be drawn from the marine animal remains. The impression that molluscs were more important than fish may be due simply to differential recovery of shells versus small fish bones. Taking the assemblages at face value, they seem to reflect a shore-based rather than seafaring exploitation of marine resources. Vrysi and Erimi, separated from the Anatolian mainland by less than 100 km, were using Anatolian obsidian; at Paralimni, however, obsidian is absent (McCartney 2008). In contrast to the “seafaring ethos” of the Epipaleolithic and Early Neolithic in the Eastern Mediterranean (Broodbank 2006), the Ceramic Neolithic on Cyprus may have been one of reduced contact with outside communities (Clarke 2007a). For individual villages, the degree of contact with off-island groups may have been largely a function of local conditions--distance, sea conditions at different times of year, and personal relationships. To what degree these contacts represented a “social safety net” for some or all members of Neolithic villages on Cyprus is difficult

to infer from present evidence, but commonalities or affinities in material culture between Cyprus and Anatolia and the Levant are not so pronounced as in other periods.

One of the most significant processes in the Ceramic Neolithic is the adoption of new storage technology, namely pottery, and the association of storage, processing and consumption with interior space in individual structures. It would be unwise *prima facie* to equate such structures with family “units”; beyond which we know very little about the nature of such units, polygynous, exogamous, patrilocal or otherwise (cf. Adams 1973, Flannery 1972). However, as Clarke has argued, changes in the built environment on Cyprus from the 7th to 4th millennia BCE reflect significant social changes (Clarke 2007a, 125; Papaconstantinou 2005). The social consequences of “private” storage, processing, and consumption are major questions in the study of village societies and the emergence of social inequality (Flannery 1972; Sahlins 1972; Saidel 1993; Flannery 1993; Blanton 1995; Feinman 1995; Price 1995; Arnold 1996; Coupland 1996; Chapman 1996; Hayden 1995; Hayden 1996).

In this light, differences in size and construction among structures deserve more careful attention than I have been able to give them in this study; readers are referred to Clarke's (2007a, 110-125) summary of changes in settlement structures, which provides an excellent and up to date introduction. Large structures like House 22 at Nysia and House 3 at Kantou, both stratigraphically early, and the concentration of craft production and ritual material in older sectors at Vrysi and Sotira (Peltenburg 1978, 61; Peltenburg 1985, 57; Stanley Price 1979b, 76-8), might provide reason to

suspect that early in the life-cycles of these settlements some households or groups had differential ability to mobilize labor for construction—and therefore for intensification of food production and generation of more surplus than other community members. However, the ethnographic record, useful as ever for restraining archaeologists' tendency to generalize, suggests a wide range of other possibilities for large structures in small-scale societies: as “mens' houses,” structures for the segregation of menstruating women, headquarters of secret societies, communal craft workshops.

The extensive use of pits at both earlier sites (Sotira) and later ones (Pamboules) relates as much to habitation or other activities (ritual?) underground as to storage. From a set of worldwide cases, Gilman has argued that the use of pit structures most often occurs along with other cultural practices including the use of stored food and high residential mobility (Gilman 1987), while Clarke (2007a) has compared them with subterranean at Shiqmim in the Negev (for literature, see Levy 1995). We should consider that the relatively large number of documented Ceramic Neolithic sites may bely a pattern of seasonal mobility, dual residence, and the infrequent use of special-purpose sites. These issues are addressed in greater detail in Chapter 6.

Evidence from archaeological gazetteers and surveys sheds additional light on the subsistence practice of Ceramic Neolithic communities—using the word here in a broad sense, not synonymous with villages. Stanley Price counted (1979: 80) Erimi culture sites, to which can be added more Ceramic Neolithic sites from survey. These

are mostly small, and many are ephemeral; while they may occur in clusters, as in the lower Vasilikos valley, site spacing appears more generous than for Chalcolithic site clusters like that around Lemba, discussed in the next chapter, and competition for land, water, and game seems unlikely to have been a factor. It is hardly surprising to find sites adjacent to water sources, whether rivers or springs: what is less predictable is how many small sites seem to have been located at some distance from water sources, for example in the upper reaches of the Vasilikos valley, and in parts of the island which tend to receive less rain.

There is no evidence to support the existence of site hierarchies or asymmetric power relations among sites: between Sotira and Kantou, for example, or between Vrysi and Teppes. That said, Vrysi, Kantou, and Paralimni all provide evidence for real defensive precautions, first and foremost substantial walls and ditches enclosing the early stages of the settlement, second in the form of weapons such as the sling stones and mace heads from Paralimni; axes would have made efficient expedient weapons, and projectile weapons can probably be assumed to have been used to take deer, so possibly against other people. There is no evidence that any of the “fortified” sites was ever raided in such a way as to result in the destruction of the whole or even a part of the settlement (Dikaios attributed the Period III destruction at Sotira to an earthquake). Paralimni clearly expanded outside the original settlement walls, and there is an absence of well-studied human remains that might provide further evidence of conflict.

In summary, the main evidence for the nature of subsistence-related stress in

the Ceramic Neolithic derives from independent evidence of climate changes which may have contributed to increasing aridification beginning, as I have argued, ca. 5000 BCE rather than in the Khirokitean. A striking diversity of structure forms, site sizes and layouts, and animal economies probably reflects heterogeneous cultural backgrounds and connections and a diversity of subsistence strategies and practices—many of which are unfortunately not visible in the extant archaeological record. However, as Croft noted (1991), the importance of hunting stands out as an apparently universal component of these different strategies at the site level (that is, individual practice may still have been different). The long survival of deer hunting and the secondary role played by animal husbandry for most of the Early Prehistoric period are among the most interesting features of early agricultural societies in this region, and are discussed further in Chapter 6.

CHAPTER 5

SUBSISTENCE PRACTICE IN THE CHALCOLITHIC

This chapter examines evidence for variation and change in subsistence practice in the Chalcolithic of Cyprus. As in previous chapters, faunal, botanical, and other environmental data are reviewed on a site-by-site basis, along with changes in strategies at the site level. The nature of resource stress and changes in strategies at the regional level are addressed in the second part of the chapter.

The transition from the Late Neolithic to the Chalcolithic is still not well understood (Watkins 1973; Bolger 1988; Peltenburg 2003; Todd and Croft 2004; Steel 2001; Clarke 2007a; Clarke 2007b). Just as there is an apparent hiatus between the Aceramic and the Ceramic Neolithic, so between the Late Neolithic and the Chalcolithic there is an interval of some 500-1000 years, based on dates from Vrysi and Kantou on one end and Mylouthkia on the other (Manning 1998; Peltenburg 2003; Clarke 2007a). However, many sites, like Tenta and Kalavassos *Pamboules*, have both Late Neolithic and Early Chalcolithic material. It is uncertain therefore whether the island was abandoned during this interval, or whether Late Neolithic people became highly mobile, perhaps in the context of pastoral strategies, and consequently left little material culture in concentrated, stratified contexts, perhaps visiting old village sites

intermittently but not returning to occupy them seasonally or year-round until later (Peltenburg 2003; Clarke 2007a).

The Early Chalcolithic on Cyprus begins nearly 1500 years later than in the southern Levant—a situation not dissimilar in some respects to the “late” adoption of pottery on Cyprus (Clarke 2007a) and illustrative of the shortcomings of the “three age system” as a universal chronological framework. Indeed, only a small handful of copper objects are known on Cyprus before the Late Chalcolithic (Gale 1991; Croft and Peltenburg 2003). The earliest Chalcolithic sites, like Kissonerga *Mylouthkia*, Kalavassos *Ayiou*, and Kalavassos *Pampoules*, incorporate subterranean complexes of pits and tunnels, not unlike Neolithic sites such as Vrysi and Kokkinoyia. Some of these sites had Neolithic components, though not in direct stratigraphic association with the Early Chalcolithic levels, leaving open the possibility of a period of abandonment, though it is equally possible at some sites, like Mosphilia, that Late Neolithic and perhaps transitional Neolithic-Chalcolithic contexts were destroyed by erosion (Peltenburg 1998). Overall, there is a high degree of ceramic continuity between the Late Neolithic and Early Chalcolithic, with the survival of Combed Ware into the Early Chalcolithic and the continued use and development of the Red-on-White style (Bolger 1988; Clarke 2001). However, there is also a high degree of variation island-wide in Chalcolithic wares (Bolger 1988, 123-130; Todd 1991).

The Middle and Late phases of the Chalcolithic are better documented, due in part to the widespread use of more permanent architectural forms (Clarke 2007a). The Middle Chalcolithic saw the development of large sites, sometimes occurring in

clusters, as in the vicinity of Lemba in the Ktima lowlands of western Cyprus. These Chalcolithic villages were an order of magnitude larger than their Neolithic counterparts, probably arguing a substantial increase in population. Their animal economies were dependent on herding and animal husbandry, primarily of pigs and ovicaprids; but fallow deer continued to be important (Croft 1991). In addition to Dikaios' work at Erimi, the work of Edgar Peltenburg and his group at Lemba *Lakkous*, *Kissonerga Mosphilia*, and the settlement and cemeteries at Souskiou *Laona* and Souskiou *Vathyrkakas* has been instrumental in advancing our understanding of social change in the Middle and Late Chalcolithic. Peltenburg has argued that the Middle Chalcolithic period saw the emergence of property rights and increased social inequality (Peltenburg et al. 1998). The relationship of these changes to subsistence and risk management at the level of individual households and communities is discussed at some length in the second part of this chapter.

Towards the end of the Middle Chalcolithic, some settlements were apparently abandoned, while at others there is evidence for destructions (as of the large, important Pithos House at *Mosphilia*). At other sites, new forms of material culture appear (Peltenburg 1985). Cypriot archaeology has often looked to migrations, invasions, and cultural “influence” from the rest of Southwest Asia to explain changes in material culture and social organization (Knapp 2008, 1). Indeed, the historical record suggests both that large-scale population movements do periodically take place, and that they are capable of producing cultural change in the regions concerned, though this seldom amounts to a straightforward replacement of people or material

culture. Late Chalcolithic material cultural has been argued to have many affinities with mainland Anatolia. Ironically, it is difficult to explore the problem of Anatolian influence or migration since the part of the island nearest Anatolia is under what amounts to Turkish control. Many known Chalcolithic sites on the northern coastal plain are currently inaccessible; published information does not include sufficient environmental data to characterize their economies or productive strategies. The sites addressed here are spatially concentrated in the south and west of the island, which constitutes a real problem for analysis, since they may not be representative of trends everywhere on Cyprus.

Ceramic studies have tended to contrast the regionalism of the Late Neolithic with the island-wide Red-on-White Close Line style of the Early and Middle Chalcolithic, which appears to have been derived from ceramic styles current at northern sites like Vrysi in the Late Neolithic (Bolger 1991b). However, the Middle and Late Chalcolithic see increased regional variation in ceramic style and the introduction of new shapes (Bolger 1988; Bolger 1991b; Peltenburg et al. 2006; Clarke 2001; Clarke 2007b). While conceding a certain level of validity to the arguments of Hamilakis (2000) and others who emphasize the social significance of food, I have argued above, in Chapter 2, that it is not wholly unreasonable to distinguish between subsistence practice, getting enough calories and nutrients to satisfy biological needs, and food ways, what is done with those calories. Nevertheless, consumptive practice can never be wholly separated from risk. Information about such practice in different Chalcolithic communities can be gleaned

from the disposition of areas for food preparation and consumption, as well as the ceramic assemblages related to the presentation and consumption of food.

As with previous chapters, this follows a fairly straightforward structure. Evidence for subsistence practice and risk is reviewed on a site-to-site basis. It has not been possible to review all excavated sites, much less all known sites; instead, I have focused on a small sample of well-excavated and published sites in combination with archaeological survey data. For the Chalcolithic, considerably more data from archaeological survey are available than for previous periods: data from a few important surveys are summarized after the discussion of individual sites. While environmental change in the Eastern Mediterranean region in the 6th and 5th millennia BP is relatively poorly understood (cf. Gomez et al. 2004), evidence is briefly reviewed at the end of the first section of this chapter. The second section reviews and summarizes information for subsistence practice and risk over the course of the Chalcolithic.

Chalcolithic Cyprus clearly saw real changes in subsistence practice, developments which seem highly likely to be related to equally profound social and technological changes. It is argued below that differential access within communities to natural resources and competition among communities for certain resources were probably sources of social tension contributing to the apparent unrest in the Chalcolithic. In some sense, Chalcolithic faced a problem similar to that encountered in the Aceramic Neolithic, as long-lived sedentary communities put stress on the deer populations of their respective catchments, despite sophisticated management

strategies. As in the Aceramic, the response was apparently to intensify exploitation of domestic stock, though pigs were much more important in the Chalcolithic than they had been in the Aceramic. Farmers were also confronted with new social consequences of risk-buffering behavior, as large surpluses came under the control of relatively small groups within society.

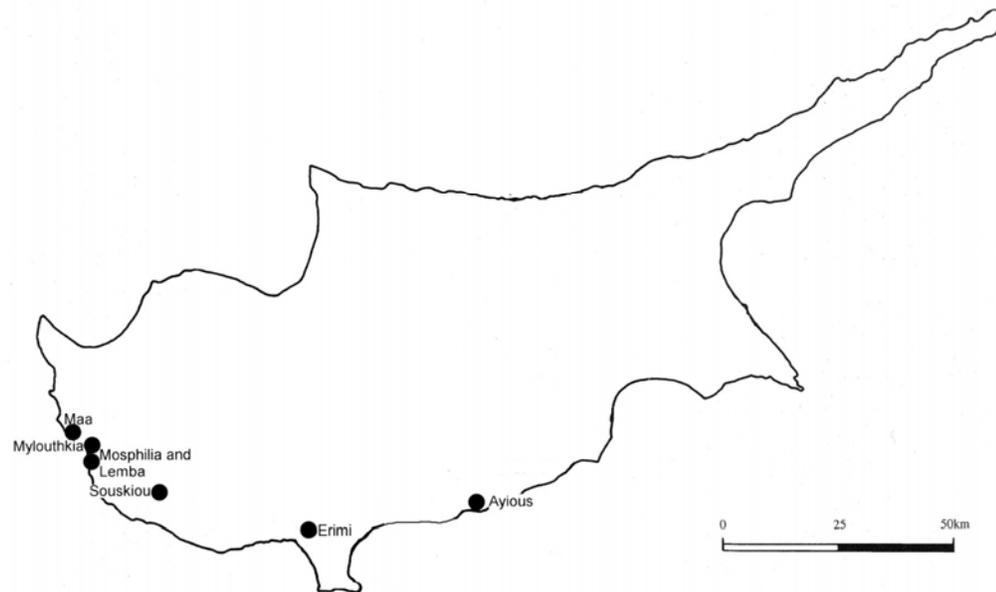


Figure 12. Map showing locations of major Chalcolithic sites discussed.

ERIMI PAMBOULA

The site of Erimi *Pamboula* (or *Bamboula*, or *Pampoula*), is located on the southern coastal plain of Cyprus, west of the modern city of Limassol and on the east bank of the Kouris river, about 5 km inland from the modern coast and some 25 km

east of the site of Souskiou (see map, Figure 12). Surface survey estimated the extent of the site at some 15 ha (Heywood et al. 1981), making it one of the larger Chalcolithic sites on Cyprus. It is usually called Erimi, to distinguish it from Kalavassos *Pamboula* in the Vasilikos valley. Erimi was initially investigated by Porphyrios Dikaios in 1934-5 and formed the basis of his definition of the Chalcolithic as an entity succeeding the “Sotira culture” or Late Neolithic by some 500 years (Dikaios 1962). Excavations by Helena Wilde Swiny and Stuart Swiny in 1981 aimed to clarify Dikaios' excavations. Much of the material from the site, especially previously unpublished material, was subsequently studied by Diane Bolger (1988). While the environmental data from the site are thinner than for some of the well-excavated sites in the Ktima lowlands, for example, they are well worth reviewing here.

In the absence of palynological, botanical, and anthracological data, reconstructions of the local environment of Erimi are necessarily limited. Historically, the southern coastal plain has experienced precipitation around 500 mm/year, with frequent drought partly offset by the good aquifers of the lower Kouris river valley; water supply may have been the single most important factor in attracting settlement, as Bolger has suggested (Bolger 1988, 15-16, 20). Bolger has argued that the volume of the Kouris river was significantly higher in prehistory. Not only would there likely have been more precipitation, less loss to evaporation, but, most significantly, much less water if any was diverted upstream of Erimi for agricultural purposes (Bolger 1988, 16 and Table 3).

1963/4 16.87
1964/5 32.2 +90%
1965/6 40.66 +26%
1966/7 55.9 +37%

*millions of cubic meters/year ; data taken from Greitzer and Constantinou 1969

Interannual variation in stream flow in the modern period has clearly been very significant. In fact, the data she presents imply interannual differences of 90%, 26% and 37% for three successive years in the combined flow of the Zygos and Kyros, which flow into the Kouris, as monitored by a United Nations study (Greitzer and Constantinou 1969). The stream flow has resulted in considerable alluviation in the lower reaches of the Kouris valley (Bolger 1988, 18). East and west of the river, and at the higher elevations of the lower Kouris valley, soils are thinner, with pockets of productive Terra Rossa (Bolger 1988, 18; Christodoulou 1959, 5). It is important to recognize that such soils are not necessarily inferior for the purposes of small-scale farmers operating without plows and animal traction. Additionally, drawing on Christodoulou's study (1959) of the placement of modern Cypriot farming villages, Bolger suggests access to a diversity of soil types was an important factor in settlement location (Bolger 1988, 18). She also proposes that Chalcolithic sites tend to be located at reconstructed boundaries between climax vegetation types (Bolger 1988, 21). To some extent soil and climax vegetation go together; but human activity and different precipitation regimes during the Holocene will also have affected vegetation. The present day vegetation regime in the vicinity of Erimi is maquis, xerophilous

varieties of scrub oak, and *Pistacia* (Bolger 1988, 19; Stanley Price 1979). Hardly, it must be noted, the preferred habitat of *Dama dama* or *Dama mesopotamica* in the present day (Chapman and Chapman 1975); but deer like humans are capable of adaptation to new conditions. It makes sense to discuss the impact of regional climate change in the Cypriot Chalcolithic after reviewing more sites, so this discussion is deferred to Section 2, below.

Dikaios' excavations did not follow natural stratigraphy but proceeded in arbitrary levels (Dikaios 1936; Bolger 1988). Nonetheless, they provide important information about ceramic phasing, architectural development, and the relationship of these to social change. These questions—pottery style and chronology and architecture as a social phenomenon—have been prominent in archaeological scholarship on the Chalcolithic ever since (Bolger 1988; Swiny 1989; Peltenburg et al. 1998; Peltenburg et al. 2003; Clarke 2007a). Briefly, Dikaios found eleven major wares, which changed over time, with Red-on-White, heterogeneous in clay, temper, and other aspects, coming to predominate (Bolger 1988, 36). However, these wares tend to run into one another to a great degree (Bolger 1988, 35-42). They were not restricted to specific pot shapes or sets of shapes, which changed slowly: trays, bowls and deep bowls, flasks, and holemouth jars being long-lived as well as common shapes (Bolger 1988, 36). Larger vessels tending to be in coarser wares (Bolger 1988), perhaps because these vessels served more for storage and potters were less inclined to decorate them than they were serving dishes; perhaps also due to the technological difficulty of firing a large pot in a finely levigated clay without destroying it.

Architecturally, an Early Chalcolithic phase of circular subterranean pithouses was followed by round timber-frame structures built on ground surface, succeeded by round pisé or mudbrick structures and finally by round structures of mudbrick on low stone socles (Dikaios 1962). Similar patterns, with some variation, occur at Kissonerga *Mylothkia* and Mosphilia (see below). Their implications for community organization, food storage, and consumption are discussed below, in the second part of this chapter.

Direct evidence for crops at Erimi is lacking, and in her re-analysis of the site Bolger (1988, 29-30) was forced to fall back on descriptions of the modern-day vegetation of the area (see below) and of botanical assemblages from Late Neolithic and other Chalcolithic sites. More information is available about the animal remains, though these were not well preserved. The bones from Erimi were first studied by King (1953), Ducos (1965) and Croft (1981, 1989, 1991). The percentages from the relatively small faunal assemblage excavated in the 1980 season, subject of an initial report by Croft in 1981, accords reasonably well with Ducos' earlier (1965) finding of 71.9% *Dama*. In later work, Croft excluded a certain number of metapodia and phalanges which pig possess and ruminants do not, and applied a rough multiplier to account for differences in live weights among these taxa to produce estimates of their importance. Even if deer bone enjoyed a higher rate of survival and recovery—and the bone from Erimi is both fragmentary and poorly preserved as compared with Mosphilia—they were clearly by far the most important source of animal protein and fat. Unfortunately, there are insufficient data to characterize changes in the relative

importance of these taxa over time.

The molluscs were studied by Wilkins (1953). As elsewhere, limpets (*Patella*) are the most important taxon; cockles (*Cardium echinatum*) also made a significant contribution to diet. No size data are available for comparison with the Mylouthkia limpets (see below). Topshells (*Monodonta*), which were over 96% of the faunal assemblage at Aetokremnos, the prehistoric site closest to Erimi, are conspicuous by their absence. The triton or conch (*Charonia*) appears at other Late Neolithic and Chalcolithic sites, where it was used as a vessel, and perhaps for a ritual purpose.

Information about the storage, processing, presentation and consumption of food at Erimi as these relate to subsistence practice comes from many different categories of evidence, none of which can be addressed more than superficially here. Briefly, the ceramic assemblage possesses a large number of trays and bowls plausibly relating to preparation and consumption of food, while storage jars and holemouth jars reflect modest quantities of ceramic storage for dry and liquid foodstuffs. The popularity of flasks and bottles, represented in a variety of wares and decorative treatments, might reflect the need to transport potable water or other liquids, though there were no doubt alternative ways of carrying liquid, for example in water skins. Without better contextual information, it is difficult to reconstruct foodways or change in these over time.

Mortars, pestles, rubbers, and pounders attest to the processing of plant foods (as well as other activities). These, in contrast to axes and adzes, tend to be expedient stones of appropriate shapes picked up in the riverbed and shaped as much by

continual use as by deliberate craft (Bolger 1988, 84). Ground stone vessels continued to be produced and, apparently, used alongside ceramic ones. No querns are noted among the groups of stone tools that can be assigned to specific structures; it is possible that use of querns occurred primarily outdoors. This possibility, however, cannot be substantiated without renewed excavation.

Considerable labor was invested in ground stone axes and adzes. These exhibit marked typological change over time--though ground stone artifacts often served multiple purposes over their lifetimes, and more highly finished artifacts like axes might be repurposed for pounding or other tasks if they broke (Bolger 1988). Bolger has argued that ground stone types from Erimi are very similar to those in the Lemba cluster of sites, discussed below (Bolger 1988, 129). She suggests that in the last phase of the settlement, axes may have been produced in specialized working areas (1988, 99); "habitual" might be as good a word. As on other Chalcolithic sites, tools plausibly interpreted as useful for woodworking, such as axes, adzes, and chisels, form quite a high percentage of the overall assemblage, though no doubt many expedient ground stone tools went unnoticed in the original excavation.

Since wooden artifacts do not preserve, it would be idle to speculate here about whether storage might have involved chests or bins like those used to store grain on some Greek islands, like Amorgos (Halstead 1987). However, it seems likely that timber was a necessary resource not only for the construction of houses or boats, but for everyday agricultural tools and implements. It is interesting to see this increase in woodworking toolkits before evidence of the advent of copper tools in any meaningful

numbers. Surviving wooden objects from the northwest coast of North America and the Pacific Rim are instructive examples of what can be accomplished by skilled woodworkers using essentially Neolithic technologies⁵.

Mortuary information for Erimi is limited. Remains of four individuals were recovered (Dikaios 1936, 1963, Niklasson 1991, 119). Burial 1 is an inhumation in a round grave: the man was buried with fragments of stag antlers and an animal shoulder bone, a Red Slip pot, and much of the body covered with large stones; the body was placed atop a layer of reddish sediment. The second adult grave is an inhumation in a pit outside and adjacent to the wall of a building, Building IXa. It appears to have cut into the foundation of the building, which was mended with red clay (Dikaios 1938b, 19). The child burial was in a stone-lined pit within a building, and the last adult was found on the floor of a building, much of the skeleton missing (Bolger 1988, 30). The heights of the three adults were estimated at 1.54m (male), 1.70m (male), and 1.51m (adult, sex indeterminate but likely female) (Bolger 1988, 30; Niklasson 1991, 120-1). This sample is clearly not significant, but it gives an average height of 1.62 meters for the two males, leaving out the partial skeleton from Building VIIIa, a figure almost exactly that estimated for the population of Khirokitia in the Aceramic Neolithic (Angel 1953; Angel 1961; Le Brun 1997, 27). None of these individuals present specific pathologies or other evidence for nutritional stress.

⁵ Some of the specifics may be counterintuitive to modern scholars without personal experience of the tasks involved. Planks, for example, are most readily made by splitting wood, not by sawing it; so claims like Broodbank's (2006) that planked boats could not have been built without copper tools are questionable.

The relationship among Chalcolithic sites, and the likely existence of communities with ties that transcended site boundaries, are important issues for this period (Peltenburg 1991; Peltenburg 1993; Peltenburg et al. 2005). While the exact nature of Erimi people's relations with other Chalcolithic villagers remains unclear, there is abundant evidence for contact and exchange. One major line of evidence is the distribution of picrolite, a soft stone used for sculpting figurines and artifacts interpreted as personal ornaments. The Kouris river is one major source of this stone. Cobbles were transported down the river bed and were readily accessible. They were transported in their raw state, as we know from chunks of picrolite found at other Chalcolithic sites. People outside Erimi clearly had access, directly or indirectly, to the sources of picrolite in the Kouris and Dhiarizzos river valleys (Peltenburg 1987; Xenophontos 1991).

Picrolite was not the only raw material traded at a distance. While sourcing chert is difficult, the use of a multiplicity of chert sources implies procurement outside restricted site catchments (McCartney 2003). Elliot has suggested (1981) that ground stone procurement was structured on an island-wide basis. How such activity may have served to maintain links among communities, and its effects on subsistence practice and stress, are dealt with below. Another trend to consider in connection with intercommunity relations is the increasing regional diversity of ceramic styles in the Middle and Late Chalcolithic (Bolger 1988, 123-130; Clarke 2007). Such divergence in ceramics might reflect tensions contributing to the articulation of local identities; I suggest in the second part of this chapter that competition for hunting territories might

be one source of such tensions.

KALAVASOS-AYIOUS AND KALAVASOS-PAMBOULES

The site of Kalavasos *Ayious* is located on a low plateau on the east bank of the Vasilikos river, just east of the important Aceramic site of Kalavasos *Tenta* and virtually adjacent to Kokkinoyia and Pamboules (Dikaios 1962, 133-40; Todd 1991, Todd 2004, Clarke et al. 2007). Held locates it in vegetation zone 8: “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy,” in a zone receiving 400-500 mm of year per year, and in soil zone 6+8+10, Interface of Calcareous Raw Soils, deep Xerorendzinas on limestones, chalks, Pliocene marls, and very deep calcareous deposits, and Alluvial Soils (Held 1992, 96).

Rescue excavations at Ayious were undertaken by the Vasilikos Valley project before the construction of the new Nicosia-Limasol highway. They revealed a site consisting of over a hundred pits, some more than 2m deep, but without any traces of built architecture (Todd 1991). Of these pits, some are bell-shaped and interpreted as storage features, while others are more amorphous; excavations also revealed carefully cut tunnels connecting some of the pits. The position of the recovered post holes and stake holes did not permit the reconstruction of any above-ground structures, but the excavator interprets the site as a settlement of ephemeral huts or houses in association with these troglodytic features (Todd 1991, 5). While plowing may have removed traces of above-ground architecture, the opinion of the excavators was that Ayious

“represents the remains of some specialized activity, the nature of which is not indubitably indicated by the archaeological record” (Todd, Croft and Kingsnorth 2004, 214).

There is very limited evidence for environmental deterioration in the vicinity of Ayious: the excavators noted a *terra rossa* soil with calcretions, overlain with aeolian sand (Todd, Croft and Kingsnorth 2004, 216-217; cf. Held 1992, 98). They suggest that wet post-Pleistocene conditions were suitable for the formation of a muddy *terra rossa*, that subsequent aridification produced the calcretions, followed by aeolian deposition of sandy sediments (Todd, Croft and Kingsnorth 2004, 217). However, as they note, this is at odds with other environmental data which suggest rising sea levels, and a relatively warm, moist climate in the Chalcolithic (King 1987). The faunal changes from Neolithic Tenta to Chalcolithic Ayious, with increasing emphasis on deer, are argued to reflect a more open vegetation regime (Todd, Croft and Kingsnorth 2004, 217), presumably, on the assumption that deer prefer a more open environment than pigs or caprines, the reverse of what is generally thought to be the case. Especially at Ayious, where the caprines are mostly sheep, it would seem unwise to infer such vegetation changes. The relative size and longevity of the two sites also deserve consideration: a short-lived site like Ayious, used for undetermined purposes and perhaps not inhabited year-round, will have had different requirements and a different impact on its local environment than a longer-lived site such as Tenta.

There is a relatively small sample of radiocarbon determinations from the site. The original radiocarbon determinations were published, so these can be recalibrated

using OxCal 4.1 and the IntCal 04 calibration curve. Thus, the 5040 +/- 110 BP determination gives an absolute date around 3636 cal BC; the 5000 +/- 170 BP determination gives a calibrated date of 3498 cal BC; The 5030 +/- 120 BP determination gives a calibrated date of 3631 cal BC; and the 4700 +/- 310 BP determination gives a calibrated date of 2834 cal BC. (Todd 1991, 11; Todd, Croft and Kingsnorth 2004, 219, Table 44). On the basis of these determinations, the site is reasonably dated to 3750-3500 cal BC (Todd and Croft 2004, 219; Knapp, Held and Manning 1994, fig 6). However, the last determination, 4700 +/- 310 BP, is statistically likely to be much later than the cluster of dates represented by the first three determinations. Several of these dates occur at the bottom of a long slope in the calibration curve: the probability plot resembles a plateau. Dates are at a confidence of lower than 95% (1 sigma). In any case, it is unwise to assume contemporaneity with other Chalcolithic sites in the region. For example, based on seriation of ceramic material from pits at Tenta, Baird has suggested (2004) that the site may have been occupied during a hiatus in the occupation of Ayious. The difficulty in establishing the durations of occupation and the relative chronology of sites in the Vasilikos valley is frustrating. Fortunately, not all of these problems need to be solved in order to say something about subsistence practice and stress. As Todd has rightly pointed out (1991), shifting patterns of habitation and what Peltenburg has called “resistance to complexity” (1993) are themselves informative regarding economic activity and social relations.

The secondary deposition of much of the material at Ayious creates problems

for the characterization of its subsistence economy. Very few plant remains were identified: these included emmer wheat (*Triticum dicoccum*) and wild barely (*Hordeum sativum*) mallow (*Malva*), oats (*Avena*), and domestic lentils (*Lens culinaris*) (Hansen 2004, 200). The animal bones clearly represent a very attenuated assemblage favoring more robust bones; additionally, because of the rescue nature of the excavations, standards of recovery were variable (Croft 2004, 200). The spatial bias revealed at Vrysi, where house floors produced twice the caprine bones as fill and middens (Legge 1982), led Croft to wonder whether caprine bones might be underrepresented in the pits of Ayious. Clearly, however, deer were one of the most important resources exploited at the site, accounting for more than 70% of the faunal assemblage (Todd 1991; Todd and Croft 2004, 74), while other species were much less important (see Table 2).

Sheep were far more abundant than goats, at 31 out of 32 elements identified to genus (Croft 2004, 205). The epiphysial fusion data for deer are problematic since smaller and more gracile bones enjoyed lower survival here than at other sites, but teeth suggest a mortality pattern in which 29% of deer died before 22 months, and no more than 44% surviving to adulthood (Croft 2004, 205). Shed antler was gathered and processed , as at Mylouthkia, Lemba, and Vrysi (Croft 2004, 207).

No mortality pattern was recovered for caprines or pig. As Croft observed, no change was observed in the composition of the faunal assemblage over time (Croft 2004, 206). Considering that Ayious may have been a very short-lived site, this is not entirely surprising. Few avian bones were identified: one belonging to a crow (Croft

2004, 206). Ayios likewise produced a fairly small sample of marine molluscs: *Monodonta* and *Patella* are both represented, but are found together in only one context, C 11 C, 5.2. The edible *Murex trunculus* was also recovered. The molluscs included some which would have thrived in brackish water (Demetropoulos and Eracleous-Argyrou 2004), perhaps transported to the site along with reeds, seaweed, or other material recovered from the estuarine end of the Vasilikos River.

In a site consisting largely of pits, these purpose and uses of which remain in many cases unclear, the questions of storage, food preparation and consumption are more than usually vexed. Some pits filled with ash and stones were clearly hearths, while others with stone-lined sides may have been used for cooking, or for firing pottery (Todd, Croft and Kingsnorth 2004, 213-214). Kingsnorth thought at least two pits, one plaster-lined, likely candidates for storage facilities (Todd, Croft and Kingsnorth 2004, 214). Arguably, most bell-shaped pits, like those at Mylouthkia, were probably intended for grain storage—though subsequently they may have been appropriated for refuse disposal or other uses-- not only because of the care put into their construction, but the thermal properties of these pits and their use later in antiquity and in the early modern period for grain storage (Todd, Croft and Kingsnorth 2004, 214; see also Krestos 1956 and Reynolds 1974).

The human skeletal remains from Mylouthkia represent three individuals, none well preserved; no pathologies were identified (Moyer and Todd 2004). In passing, it is interesting to note that 37 fragments of human figurines, and none of animals, were recovered at Ayios (South 2004, 191). Whatever the special purposes served by this

site, it was not apparently used for burials (Moyer and Todd 2004, 198), but whatever activities required figurines were conducted at Ayious just as at other Chalcolithic sites. Equally interesting is the fact that of these figurines, not one is of the cruciform type ubiquitous in the Chalcolithic in the western part of the island: no examples of such cruciform figurines are known in the Vasilikos region (Todd, Croft and Kingsnorth 2004, 220). What this reflects about the spatial dimensions of symbolic behavior deserves further consideration.

Kalavassos *Pamboules* is just as important as Ayious, since it not only sheds light on the Neolithic-Chalcolithic transition in the Vasilikos region, but preserves a full ceramic sequence from Early to Late Chalcolithic as well. Early and Middle Chalcolithic phases at the site consist entirely of pits, while the Late Chalcolithic saw the construction of a rectilinear building, an apparent novelty for Cyprus (Clarke 2004). Pampoules possesses a small faunal assemblage. It was not like Kokkinoyia, a special purpose site at which butchery was not undertaken; rather, the material is simply very limited. Material from Dikaios' 1947 excavations was subject to unknown preservational and recovery bias and unable to be assigned to specific levels (Clarke et al. 2007). However, the distribution of species gives a picture not unlike Ayious and other Early Chalcolithic sites (see Table 2).

While the overall numbers are roughly comparable to Ayious, material from earlier contexts may reflect a lower contribution by deer (around 57%) and correspondingly higher proportional contributions by caprines (28%) and pig (15%) (Clarke et al. 2007, Table 20). Interestingly, while close to several apparently

contemporary Chalcolithic sites, Pamboules is nearly 0.5 km from the nearest known water source, the Vasilikos river (Clarke et al. 2007, 46). Survey evidence for the Chalcolithic in the Vasilikos valley is discussed in more detail below.

LEMBA LAKKOUS

The site of Lemba *Lakkous* is one of a number of important Chalcolithic sites in the Ktima lowlands, in the vicinity of the modern village of Lemba in western Cyprus (see map, Figure 12). The village has given its name to the Lemba Archaeological Project (LAP), a group which has been exceptionally active in this region for forty years. LAP also excavated at the sites of Mylouthkia and Mosphilia and continues to work at the settlement of Souskiou and its cemeteries (all three locations are discussed below). Lemba *Lakkous* is situated quite close to the modern coastline, on a sloping marine terrace about 2 km wide West to East, between the erosional gullies of two seasonal streams, the Potamos tou Kocha and Argaki tou Taisi (Xenophontos 1985). Smaller erosional gullies on the site as well as the fact that parts of it have been deeply plowed, complicate understanding of stratigraphy. Like other sites in the Ktima lowlands, Held places Lemba in climax vegetation zone 9, “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy” and in soil zones 2+10: “interface of terra rossa on kafkalla; and alluvial soils” (Held 1992, 137). It lies in a zone tending to receive 400-500 mm of rainfall annually; in addition to cereal dry farming, irrigated vegetables and bananas are major crops (Held 1992, 137).

The area of the site was estimated at ca. 3 ha. (Peltenburg 1985, 9), significantly smaller than Kissonerga *Mosphilia* or Kissonerga *Mylouthkia*. Additionally, it appears to have been less densely occupied than Mylouthkia (Todd 1991, 18). It appears to be a small agricultural village, with perhaps 240 people based on a rough estimate of the total roofed area occupied at any given time (Todd 1991, 18). Such an estimate is, of course, an educated guess, but provides a useful point of comparison with, for example, Mylouthkia, which was apparently a far larger and more densely populated settlement.

Two areas at Lemba, Area I and Area II, less than 100m apart, were excavated (Peltenburg 1985). Within these, the excavators identified three chronological phases, Periods 1, 2, and 3. All three phases are dated by radiocarbon samples, for which date ranges (uncalibrated and calibrated using the latest version of OxCal) are as follows:

Period 1 5000 +/- 260 to 4280 +/- 100 bp (uncalibrated) = 3265 cal BC to 2580 cal BC

Period 2 3930 +/- 100 bp (uncalibrated) = 2137 cal BC

Period 3 4090 +/-90 to 3890 +/- 50 bp (uncalibrated) = 2461 to 2205 cal BC

(Peltenburg 1985, Table 2. NB: I have not used Peltenburg's calibrated dates, but have updated the determinations using OxCal v. 4.10 and the Intcal 04 calibration curve).

Some problems are immediately evident. The earliest (uncalibrated) date for

Period 1 was thought by the excavator to overlap significantly with the Late Neolithic (Peltenburg 1985, 17), but this is solved by recalibration. Only one date was obtained for Period 2. This date places it within if not later than the range assigned to Period 3, but may be earlier at two standard deviations, and is thought to be earlier on stratigraphic grounds (Peltenburg 1985). The most recent calibrated dates for Period 3 are much more recent than are usually assigned to the Chalcolithic, conventionally dated ca. 4000-2500 BC (e.g. by Steel 2004, Table 1.1), running through the Philia phase and into the Early Cypriot Bronze Age. However, these are complicated by the shape of the calibration curve: the probability distribution produces multiple peaks. The 4090 date could be 2900 cal BC and still within 95% confidence (1 sigma).

Botanical remains from Lemba were studied by Sue Colledge. They derive from floated contexts in graves, occupation levels within structures, the fabric of mud bricks, and fire pits (Colledge 1985b, 209). Selection of contexts for examination was at the discretion of the director and there was no formal sampling strategy; nor, in most cases, records of the volume of the deposit (Colledge 1985a, 101). All samples were charred; preservation was found to be almost uniformly poor (Colledge 1985a, 101).

In Area I, identified flora included pistachio or lentisk (*Pistacia*), lentils (*Lens*), which might be either large wild lentils or small domestic ones, ryegrass (*Lolium*), bedstraw (*Galium*), and grass seeds which could not be better identified (Colledge 1985a, 102). Area II yielded substantially greater quantities of plant remains than Area I. The botanicals include hulled, 6-row barley (*Hordeum sativum*) in all

contexts, many indeterminate fragments of cereals, probably representing charred processing waste, and one example of bread wheat (*Triticum aestivum*). Colledge has suggested, with reservations, that perhaps it was not possible to cultivate wheat at Lemba due to local environmental conditions (1985c, 297).

Pulses and wild plant foods, or plants whose domestic or wild status was not able to be established, include lentils (*Lens*), olives (*Olea*), Pistachio or lentisk (*Pistacia*), figs (*Ficus*), and grape, of which one whole grape seed was identified as *Vitis vinifera* ssp. *Sylvestris*, its pip more closely resembling wild than domestic grapes (Colledge 1985b, 209). The pollen sample attests to the presence of numerous varieties of edible wild plants, including plaintain (*Plantago*) and mallow (*Malva*) (Renault-Miskovsky 1985).

A number of wild grasses, meadow plants, and reeds were also identified. Canary grass (*Phalaris*), ryegrass (*Lolium*), buglosses (*Buglossoides*), and brome (*Bromus*) might have grown alongside and intermixed with cereal crops, in fallowed or abandoned fields, or in open area in the vicinity of the site. They generally suggest the presence of dry, open fields, but kernels of sedges (*Cyperaceae*), indicate that somewhere in the vicinity, probably close to the river, there was moist habitat suitable for these plants (Colledge 1985b, 209). Palynology, however, suggests that the area may have become much dryer in Periods II and III (Renault-Miskovsky 1985).

It is not possible to make strong arguments regarding spatial patterning and change over time in the botanical assemblage. None of these samples derive from contexts that obviously relate to storage. The processes that led to their charring and

incorporation in various deposits are not well understood. In comparison with data from the other sites reviewed in this chapter, they suggest the exploitation of a “normal” range of Chalcolithic cultivars and wild food crops.

The animal bone from Lemba was studied by Paul Croft. (Croft 1985a, 1985b). The bone assemblage from Area I was small (n=310). Adjusting the count of postcranial fragments to account for differences in skeletal morphology (i.e., the cannon bone of ruminants as against the many metapodial bones of pigs), Croft calculated percentages of identified postcranial fragments and species contributions to the meat supply at Lemba (Table 2).

While the part of the assemblage for which epiphyseal fusion can be examined is quite small, the data suggest that 4% of deer died as infants, a further 18% as juveniles, 19% in subadulthood, and 59% as adults (Croft 1985a, Table 60). In absolute terms, infants are < 1 year, juveniles from 1 to 1.5 or 2.5 years, subadults from 1.5 or 2.5 to 2.5 or 2.5 years, and adults older than 2.5 or 3.5 years (Croft 2003d, 229). Teeth from fallow deer were not recovered in sufficient numbers to serve as a check to these mortality estimates (Croft 1985a, 99).

Epiphyseal fusion data for the pigs are inconsistent: unfused elements are likely underrepresented for the juveniles; Croft ventures, however, that many pigs died as infants (1985a, 100). Mortality data for the caprines are equally scanty and unreliable, but these appear to have survived in larger numbers into adulthood (Croft 1985a, 100). Just under half of postcranial fragments were identified as goat, none as sheep (Croft 1985a, 100). The presence of fox bones is worth noting simply as a recurring—indeed,

almost universal—feature of Early Prehistoric assemblages.

Area II produced nearly three times the number of bones recovered from Area I. Percentages for the main identified taxa, adjusted as above for the different limb morphologies of ruminants and pigs, were different than Area I, with deer somewhat less important and pig somewhat more important (See Table 2). However, this disguises a substantial degree of change over time. In Period 1, using combined data from Areas I and II, deer were 61.8 of the adjusted fauna, and perhaps 70% of the meat supply. In Period 2 in Area II they total 47.4% of the assemblage and perhaps 57.3% of the meat supply, and in Period 3 in Area II they account for only 34.2% of identified elements, and some 39.1% of the meat supply (Croft 1985b, Tables 127, 128 and 129). Deer thus decreased substantially in importance over the occupation of the site. The number of antler bases recovered suggest that deer declined not only as a percentage of the total assemblage, but in real numbers (Croft 1985c, 296). Caprines contributed about 6-10% of the meat supply over this time frame, and pigs apparently became more important as time went on: by Period 3 they may have furnished more than 50% of the meat consumed at Lemba (Croft 1985b, 204 and Table 128). It is instructive to compare this change with the nearby sites of Mylouthkia and Mosphilia, where a similar trend is evident, but much less marked in degree (see below).

Elements which permit analysis of age profiles are too scanty to break down by period, but the overall picture in Area II is very similar to that in Area I, with few infants taken, some juveniles, more subadults (probably mostly males) and the most deer dying as adults (Croft 1985b, 204-5 and Table 130). Here too mortality data for

pigs are similar to Area I, with a high cull among infant and juvenile piglets (Croft 1985b, Table 131). The high number of juveniles means that pigs may have made a less significant total contribution to the meat supply than suggested by identified fragments alone, though the smaller, less robust bones of young pigs will also have preserved and been recovered at a lower rate than those of older pigs and deer.

The caprines from Area II are predominantly (87.5% to 91%) goats, with a much smaller (9% to 12.5%) fraction of sheep; the exact percentages depend on whether some doubtful first phalanges are included or excluded (Croft 1985b, 205-6). Epiphysial fusion (Croft 1985b, 206) indicates that nearly 50% of goats (and a small number of sheep) had died by the end of the juvenile phase, probably surplus males; the 50% or so that lived into adulthood were likely females, with the retention of a few males for breeding purposes. This pattern is markedly unlike that at Mylouthkia and Mosphilia (see below).

Several astralagi were assigned first to red deer, then tentatively to cattle, but this attribution is not secure (Croft 1985b, 206-7). Fox, dog, and cat are attested as small fractions of the bone assemblage (Croft 1985b, 207). Fox occur in context with food remains and may have been eaten, as well as skinned for their pelts (Croft 1985b, 207).

The spatial distribution of these faunal taxa is interesting. A much higher percentage of pig bones than deer bones were found inside structures. Croft suggests that this has to do with patterns of discard, with young pig bones being lost or discarded on floors while deer bones were thrown away outside (1985b, 208). This

seems reasonable, but it may be worth considering another possibility, to which I have alluded in previous chapters : that this disparity reflects a real difference in patterns of consumption, with domestic livestock under the “private” ownership of individuals, households, or kin groups, while herds of deer were communal property, with hunted deer disproportionately shared and eaten outdoors in more public settings. This hypothesis is discussed in greater detail below in Part 2 of this chapter, especially as it relates to the deer bones from the Pithos House at Mosphilia. Given the gnawed character of many of the bones, dogs probably also had a role to play in distributing the faunal assemblage.

The marine invertebrates from Lemba were studied by Janet Ridout Sharpe. In Area I, many come from the plow zone or mixed deposits rather than uncontaminated contexts (Ridout Sharpe 1985a, 103). The sample recovered from Area II is much larger than that from Area I, with better contextual information. However, the range of species represented is similar (Ridout Sharpe 1985a, 1985b). Cockles (*Glycymeris glycymeris*) and smooth clam (*Callista chione*) were abundant, followed by limpets (Patellidae) (Ridout Sharpe 1985b, Table 137). The smooth clam is exploited in the Eastern Mediterranean in the present day, and scientific observations of growth under certain recorded parameters (Metaxatos 2004) could provide information about human and paleoenvironmental impact on local shellfish populations, given better data. Interestingly, however, this species is not well represented at other Chalcolithic sites. Topshells (*Monodonta*) were rare in all periods and in both Areas I and II, in contrast to many other Early Prehistoric sites. Crabs are relatively abundant, with 19 recorded

from Area I (Ridout Sharpe 1985a, 105).

Ridout Sharpe noted the number of beachworn shells mixed with unworn examples (1985a, 105), suggesting shells—especially e.g. *Dentalium*—might have been worn as ornaments or used in some industry such as the manufacture of shell beads. Eight triton shells (*Charonia*) were recovered: these are unlikely to have constituted food debris and may have been used as vessels, or even for a ritual purpose, as in the Ceremonial Area at Mosphilia, discussed below, though nothing about their contexts suggests this was the case. The vast quantities of land snails mostly derive from flotation, and are thought to be intrusive (Ridout Sharpe 1985b, 212).

The human remains from Lemba, representing approximately 60 individuals, constitute a sizable fraction of the dead population for Chalcolithic Cyprus. If the site's living population was indeed as small as 240 (Todd 1991, 18), the dead population constitutes a large sample; unfortunately it provides little in the way of positive evidence for subsistence practice and stress at Lemba.

Mortuary practice is variable, though single flexed inhumations in pit graves dug into bedrock, the pits covered by capstones, were most common (Niklasson 1985a; Niklasson 1985b; Niklasson 1991). There seems to be no strong patterning in the provision of grave goods, and generally little evidence for circumscribed mortuary groups (Saxe 1971), though some groups of graves are associated not only with particular structures and particular ceramic traditions (Stewart 1985a, 65). Despite the presence of seeds, pottery, and animal bone in burials, there is little evidence to

suggest what role food might have played in mortuary ritual (Peltenburg 1985) and the quern fragments placed over one or two graves seem likely to represent expedient re-use rather than the deliberate internment of domestic equipment with the dead, as may have been the case at Khirokitia (Le Brun 1997, 28).

Ages were estimated by looking at both skeletal and dental (Lund 1985a, 1985b) material. The dead population as excavated appears to reflect a very high infant and child mortality. In Area I, there is a ratio of 15 infants, children, and adolescents to 7 adults, and in Area II, 22 or 23 infants, children and adolescents to 11 adults (Niklasson 1985a, 49; Niklasson 1985b, 142). The ratio of infants, children and adolescents to adults is thus consistent between Areas I and II at slightly more than 1:2. In Period 1, most adults were probably buried outside the settlement (Peltenburg 1985, 314), or at least in another part of the settlement, while in Periods 2 and 3 adult inhumations within the settlement are more common. This partly, but only partly, accounts for the high ratio of children to adults. The possibility of a separate mortuary space for (some) adults in Periods 2 and 3 cannot be eliminated, but in the absence of other evidence it would appear that the mortality rate for young people really was high relative to other contemporary settlements. Unfortunately the skeletal record gives little indication why this should be the case. Evidence for thalassemia is not reported; nor are there indications of other pathologies or healed injuries which might shed some light on the issue.

Dental pathologies included high incidence of caries, lesions, abscesses, a certain number of teeth lost in life, heavy wear in some adults, and a number of other

pathologies, but no evidence for enamel hypoplasia (Lunt 1985a; Lunt 1985b).

Estimates of the incidence of caries are difficult given the poor preservation of some of the teeth and the high number of deciduous teeth in the sample. It is possible that the population of Lemba had a higher rate of caries than either Mylouthkia or Mosphilia, discussed below (Lunt et al. 1998, 78-9). The possibility that this reflects a difference in diet is discussed in the second part of this chapter.

Evidence for storage, processing, presentation, and consumption derives from many lines of evidence. The ground stone assemblage contains querns, rubbers, pounders, mortars, and pestles suitable for processing plant foods. As on other sites, ground stone artifacts might serve many purposes over a lifetime of use. Many apparently still useful stone tools were incorporated in walls, or used (in the case of querns) to cover graves (Peltenburg 1985, 321). Tools might also be abandoned inside a house when it went out of use, though it is also possible that they might be recovered or scavenged. Despite the fact that they occur in patterned locations within structures, it should be stressed that even large ground stone tools are portable, and grinding activities need not always have taken place where querns were stored or kept when not in use.

Not only ground stone but ceramics were used for processing. The association of seeds with individual vessels suggests that a Combed Ware tray held figs: Peltenburg has suggested (1985, 321) that these trays, found primarily in contexts outside of structures, were used for open-air drying of figs. Spouted flasks might relate to the production of beer or wine (Peltenburg 1985, 321). Peltenburg also suggested

goats' milk, but no other indication this secondary product was being exploited, nor do caprines appear from their age/sex mortality curves to have been managed for milk production anywhere on Cyprus at this time (Croft 1985b; Croft 1985c; Croft 1991). Finally, several buildings contained basins, plastered depressions, sometimes divided into compartments; at least some of these are interpreted by the excavators as facilities for food preparation, perhaps separating different comestibles (Peltenburg 1985, 230).

Over the course of the occupation of Lemba, the ceramic evidence suggests a change in storage practice and strategies. In Period 1 closed shapes are diminutive, in the range of 10-20 cm high. An indeterminate small closed shape may have held mixed pistachios, lentils, and grass seeds (Peltenburg 1985, 321; Colledge 1985a). By contrast, the storage jars and holemouths of Period 2 and 3 may reach 60 cm in height and 56 cm in diameter (Peltenburg 1985; Stewart 1985a; Stewart 1985b). Some of the Period 2-3 large jars apparently held barley (Peltenburg 1985, 321; Colledge 1985b, Table 136).

Many of these derive from an outdoor deposit comprising layers of ashy fill with stake holes and big pits, some of which contained whole or fragmentary storage vessels, is interpreted as outdoor storage (Peltenburg 1985, 128-9). Peltenburg has estimated that this so-called Store Area comprises about 7 m² of storage, which if barley is entailed might support 20 people/annum, or possibly the produce of some 11 acres, depending of course upon yields (Peltenburg 1985, 326; Christodolou 1959, 128). The presence of ground stone tools suggests some processing took place in this area. The Store Area went out of use when B 13 was built over the area (Peltenburg 1985, 129), but whether

this represents a deliberate “appropriation” of communal storage space as has been suggested for the Upper Terrace at Mosphilia (see below) is uncertain.

The Store Area is the largest, but there are similar complexes of pits elsewhere on site (Peltenburg 1985, 129). The Timbered Storage Area is another concentration of pits, many of which held storage jars. It had more post and stake holes than the Store Area, features which suggest the presence of wooden structures (Peltenburg 1985, 130-131). Again, two querns and two plastered basins found in the area suggest processing activities.

The Period 3 Underground Storage Complex consists of a central pit with niches in the havara which may have contained storage vessels (Peltenburg 1985, 133). Additional storage in houses is attested by presence of storage jars. Building B2 in Period 3 had storage jars with a capacity of almost 4 m². Using the same inputs as Peltenburg used to estimate the capacity of the Store Area (1985, 326), this is equivalent to a year's supply of barley for 11 people, or the produce of about 6 acres.

At least some food preparation and consumption probably took place indoors. Unlike Mylouthkia and Tenta, there is little evidence for subterranean architecture; Period I structures include mudbrick or pise on stone foundations. Thus, despite the chronological problems already mentioned, Lemba seems likely to be a Middle and Late Chalcolithic site. Period I Chalcolithic houses at Lemba followed a relatively standardized organizational scheme. Hearths generally occur inside buildings, with the exception of one south of building 5 (Peltenburg 1985, 314). Querns and mortars occur almost invariably in what are apparently working installations near the

entrances of buildings (Peltenburg 1985, 322). However, there are exceptions.

Peltenburg has suggested that two Period I structures were “general habitations,” one a “sleeping hut,” and one a “specialized work hut,” (1985, 324). These are not baseless claims, but naturally it is difficult to understand how internal domestic space was refashioned and repurposed at different times of the day, of the year, at different points in the life cycle of a house. No justice can be done here to the large body of evidence for ritual and symbolic behavior other than to note that the cruciform and other figurines which are so common and in the Chalcolithic of Cyprus are sometimes found in contextual association with storage; there is likely to be some relationship between symbolic behavior and agricultural and storage practices, but these are difficult to plumb.

In Period 2, the internal arrangements of structures were more heterogeneous (Peltenburg 1985, 324). Some have two hearths, and artifactual assemblages differ considerably (Peltenburg 1985, 326). The apparent absence of storage might point to communal storage facilities (Peltenburg 1985, 326); a similar pattern is seen at nearby Mosphilia.

Period 3 structures tend to be larger and more uniformly circular than the structures of Period 2. Some of these may also have served, or come to serve, special purposes. B7, for example, contained a mortar, rubbers, and basins ; there was little animal bone (Peltenburg 1985, 328). Peltenburg suggests it was a brewery (1985, 328), an intriguing possibility. Beer had been consumed in Mesopotamia and Egypt as a staple food much earlier, and chemical evidence for brewing comes from Godin

Tepe in the Zagros mountains of Iran ca. 3100 (Michael et al. 1992).

Seasonal variation in consumption practice is probable, but at least some of the time people ate indoors, probably adjacent to one or more of the hearths in the buildings, to judge from bones recovered from house floors; though outdoor consumption also likely, perhaps especially in warmer months and particularly for deer, which I suggest might have furnished meat for kin-group or community feasting. The small and medium-sized bowls in various wares and with various decoration are a consistent feature of the ceramic assemblage throughout the occupation of the site, roughly half of the total assemblage or more (Stewart 1985a; Stewart 1985b). These are suggestive of individual servings or the separate presentation of different dishes.

Evidence for the local environment derives from observation of the present-day environment, from palynological and anthracological data, and from the botanical assemblage. The Potamos tou Kocha and Argaki tou Taisi which flank the site are not year-round water sources, but they do feed perennial springs about 1 km from the site (Xenophontos 1985). The Lemba villagers may also have relied on wells like those at Mylouthkia. In addition to the proximity of water sources, Lemba's location may have been influenced by the superior quality of the sediments on the coastal plain as opposed to further inland, where shallow soils lie over a calcareous kafkalla crust that can inhibit cultivation (Xenophontos 1985).

Palynological and anthracological data from Lemba provide the outlines of an environmental history against which to read other categories of evidence, not only from Lemba itself, but from other nearby Chalcolithic sites like Mylouthkia and

Mosphilia. In Period 1, the pollen record indicates dry, relatively open grasslands. The sample is dominated throughout by the Gramineae, Cichorieae and Anthemidae, which include grasses, wildflowers and weeds such as hawkweed, dandelions, and chicory, and aromatic herbs, respectively. Chenopodia (*Chenopodiaceae*) and mallow (*Malva*), in addition to being open grassland plants, are potentially edible resources. Arboreal pollen hovers at 5% or 6% over nearly half a millennium (Renault-Miskovsky 1985, 307 and Figure 5.12). Most of the arboreal pollen is consistently pine, though Cupressaceae, probably juniper (but indistinguishable because of morphology), are also abundant. Oak and olives are barely represented, commensurate with the very low evidence for olives in the botanical assemblage (Colledge 1985a and 1985b). Representation of pollen from cereals and legumes is quite low.

In Periods 2 and 3, the pollen record suggests a trend towards a dryer climate regime. This coincides with evidence for gradual aridification and vegetation changes throughout Southwest Asia from 6000 cal BP onwards (Robinson et al. 2006, Barbier and Thiébaud 2005, Wasse 2007). Cicoreae are again the dominant family overall, but the Anthemidae increase substantially. Arboreal pollen drops, mostly as a result of the decrease in pine pollen from 5-6% of the total to around 1%. Oaks are represented in 3 out of 6 samples (as against only one for Area I) but remain at around 1% (except for the late sample 6, in which they reach nearly 20%). These oaks are identified as downy oak and holm oak, *Quercus pubescens* and *Q. ilex* respectively.

Anthracological data from Lemba are limited, but three charcoal species were able to be identified, two to mulberry or hackberry (*Morus* or *Ulmaceae*) and one to oak

(*Quercus*) (Lawrence 1985). Pollen from wet-loving plants (*Potamogeton* and *Sparganium*) present in Area I and Period 1, is absent from Area II and the two later phases of the site (Renault-Miskovsky 1985, 307). The increase in cereals and legumes is based on a small sample, but Renault-Miskovsky strongly suggests that it implies increased cultivation at this time (1985, 311).

A particularly interesting feature of the palynological data in Area II is the sudden spike in meadow-rue (*Thalictrum*), which according to Renault-Miskovsky is dangerously poisonous to humans and livestock (Renault-Miskovsky 1985, 310). Renault-Miskovsky goes so far as to argue that this would have had dramatic effects on the animal economy: “les troupeaux auraient-ils brutalement decimees” (1985, 311), perhaps even leading to the abandonment of the site. There is no evidence for such decimation as far as caprines. Neither deer nor pigs would seem likely to ingest large amounts of meadow-rue in the course of normal feeding, and empirical data on white-tailed deer browsing in eastern North America suggest these animals avoid meadow-rue (Perdomo et al. 2004). Note that based on Croft's data, reviewed above, the representation of pigs apparently increased before either the increase in meadow-rue or the modest increase in oak pollen.

Evidence from Lemba suggests that not only environmental change but contact among different cultural groups, some perhaps new arrivals to the island, played a major role in structuring the dynamics of subsistence practice and stress. Before discussing these issues, however, it is best to complete the review of Chalcolithic sites with good environmental data. I turn next to Kissonerga *Mylothkia*.

KISSONERGA MYLOUTHKIA

The location and setting of Kissonerga *Mylouthkia*, approximately 2 km north of Lemba and only a few hundred meters from Mosphilia, are described above in Chapter 3, in connection with the Aceramic Neolithic wells there. Held places it in climax vegetation zone 9, “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy” and in soil zones 2+10: “Interface of Terra Rossa on Kafkalla; and Alluvial Soils” (Held 1992, 134). Like other sites on the western coastal plain, it lies in a zone which in the 20th century has tended to receive 400-500 mm of rainfall annually.

The extent of the site is estimated at about 6 ha. Based on radiocarbon dates, Mylouthkia and Mosphilia appear to be closely contemporary (Peltenburg 2003b), and their ceramic phasing is very similar. The series of radiocarbon dates for Mylouthkia clusters tightly in the Early Chalcolithic to the early Middle Chalcolithic for Period 2, ca. 3650-3350 cal BC, with Mylouthkia Period 3 only slightly later (Peltenburg 2003, 259-61 and Figure 24.1). On the strength of both radiocarbon and ceramic phasing, therefore, it is reasonable to equate Period 2 at Mylouthkia with Period 2 at Mosphilia, Period 3 at Mylouthkia with at least the earlier part of Period 3A at Mosphilia. Additionally, Mylouthkia Periods 2 and 3 are thought to be essentially contemporary with Kalavassos *Ayious*, though the earliest dates from *Ayious* are potentially significantly earlier at 1 sigma (Peltenburg 2003, 260 and Figure 24.1). All these sites overlap chronologically with Lemba as well, though the few radiocarbon dates from

Lemba suggest a longer occupation there.

The Chalcolithic component of Mylouthkia is a complex of pits and structures, cut into an original ground surface now eroded (Peltenburg 2003). The pits were filled with a mixture of sherds, bones, and ash plausibly interpreted as dumps of household trash. Early Chalcolithic construction also included both post-frame structures within pits and round post-frame structures above ground (Building B152). The Middle Chalcolithic saw the construction of at least one structure with a stone foundation, Building 200 (Peltenburg 2003).

Botanical remains from the fills of the pits at Mylouthkia have been addressed by Sue Colledge (2003). These remains include not only carbonized seeds, but ash and wood charcoal, and derive primarily from contexts interpreted as redeposited domestic waste, with bones and pottery admixed: the botanical remains might have become charred in hearths and ovens (Colledge 2003, 244). Phytoliths observed in excavation suggest that large quantities of straw may have been placed in the pits, perhaps over top of rubbish layers (Colledge 2003, 245).

Unsurprisingly, a greater number of taxa were recovered from contexts from which larger samples were taken: the relationship between sample size and number of recovered taxa is almost linear (Colledge 2003, Figure 21.1). Food crops identified include emmer wheat (*Triticum dicoccum*), a few morphologically problematic grains which might represent a *monococcum/dicoccum* hybrid, hulled barley (*Hordeum sativum*), rye (*Secale cereale*), oats (*Avena* sp.), lentils (*Lens culinaris*), chick pea (*Cicer arietinum*), vetch (*Vicia ervilia*), figs (*Ficus*), olive (*Olea europaea*), flax

(*Linum* sp.), and *Pistacia* (Colledge 2003). Given processes of deposition and taphonomy, the relative numbers of these taxa are not likely to be highly meaningful.

With regard to the cereals, most contexts exhibited a much higher ratio of glume wheat grains to chaff than would be expected from the natural occurrence of two grains per spikelet, while fill 1.05 contained processed and cleaned grain with no chaff present (Colledge 2003, 242). It may be worth noting that this fill also contained 40 examples of storage jars, an unusually high frequency of this shape (Bolger and Shiel 2003). Processed and unprocessed barley, processed and unprocessed wheat occur in the same contexts, in Pit 16 and Pit 1 (Colledge 2003, 242). Colledge recognizes that the proportion of glumes and chaff may have been affected by taphonomic processes (Boardman and Jones 1990), but the overall abundance of grains suggest that these deposits include cereals which had been processed to remove at least some of the chaff. Lentils were by far the most common variety of pulses represented, and these are thought from their size to be domesticated lentils, *Lens culinaris* (Colledge 2003, 243). Chick pea (*Cicer arietinum*) and vetch (*Vicia ervilia*) were also identified (Colledge 2003, 243).

The wild plants may have been food sources for animals and people; some were almost certainly brought on site accidentally, with harvested cereal crops; they indicate something about the nature of the local environment. In addition to figs and pistachios, capers (*Capparis* sp.) remain a commonly component of traditional Cypriot diet. Many of the wild plants are species favoring dry, open meadows and weeds from cultivated fields : Bugloss (*Buglossoides*), mallow (*Malva*), which is edible, grasses

(*Lolium*, *Phalaris*), and Amaranth (*Amaranthus*) (Colledge 2003, 244).

The faunal remains from Mylouthkia were studied by Paul Croft (2003d). Preservation was remarked to be generally good, with less calcareous encrustation than at Lemba *Lakkous* and Kissongera *Mylouthkia*. Many of the bones showed evidence of processing, both butchery marks and breaking for marrow extraction; there is also some evidence of carnivore gnawing (Croft 2003d, 225). The representation of animals by identified fragments in Periods 2, Final Period 2, and Period 3 is given in Table 2.

It should be noted that the number of skeletal remains for Period 2 is significantly larger than for the following periods. For some analyses, therefore, Final Period 2 and Period 3 are represented by a small sample, and conclusions are necessarily less robust than could be desired. Croft cautions that percentages of identified fragments may overstate the number of pigs, since pigs have more bones than caprines or deer (metapodials rather than cannon bones), and their crania often tend to fragment into a larger number of pieces (Croft 2003d, 235). Bone weight can provide a useful counterpoint. Deer bone, for example, constituted nearly 61% of the bone assemblage for Period 2 by weight, pig bone only 22% (Croft 2003d, Table 20.13). Despite the possibility of differential recovery of larger deer versus pig bones, pigs may be overrepresented by a strict count of identified fragments. Therefore Croft offers adjusted counts of postcranial elements, excluding some pig bones like fibulae and half their metapodial bones. Finally, Croft (2003d, Table 20.14) has estimated the relative contribution of the different identified taxa to meat supply, assuming they

were exploited primarily for their meat—though, as discussed below age/sex profiles suggest that ovicaprid exploitation was far from energetically efficient, with social factors favoring strategies that gave a less than optimal return on energy (Croft 2003d, 235, cf. Russell 1995). Meat procurement may also have involved hunting a wild population of caprines, which cannot be disentangled from their domestic cousins in the faunal record. It might be that hunters favored adult males with impressive horns for reasons of social value accorded such animals. Croft also presents the animal remains by context, which illuminates some potentially significant spatial patterning in the representation of different taxa:

<u>Pit 1 (Period 2)</u>	<u>Pit 16 (period 2)</u>
deer 57.7%	deer 52.9%
caprines 25.9 %	caprines 5.1%
pig 15.2%	pig 32%
dog 0.4%	dog 1.3%
fox 0.6 %	fox 8.7%

Two fill episodes in Pit 1 had dramatically different proportions of fauna; one with more than twice the representation of caprines (15% as against 36%) (Croft 2003d, 225). It is possible that such a disparity reflects seasonality (Croft 2003d), though we know far too little about the specific depositional processes that formed

these fills to draw any such inference. Pit 16 may have been a midden, wherein organic waste, old tools, and trash from craft activities were admixed (Croft 2003d, 226; Peltenburg 2003, 266). The total number of skeletal fragments from Pit 16 is 165 fragments, excluding fragments of antler, which tend artificially to inflate the count in favor of deer (Croft 2003d, 226). Element data for this context are not given, but 165 fragments could easily derive from a small enough number of deer to have been taken by a single Chalcolithic household of, say, 4-20 people, with B 200 perhaps fitting the upper end of that range (Peltenburg 2003, Jackson 2003).

Building 152 (Period 2)

deer 63%

caprines 7%

pig 30%

Building 200 (period 3)

deer 27.1 %

caprines 4.7%

pig 65.4%

General Period 3 contexts

deer 46.3%

caprines 5.6%

pig 45.0 %

Deer are represented in much lower percentages of the fauna in Building 200 than in contemporary Period 3 deposits, while pigs occur as a higher percentage of the assemblage. There is also a pronounced difference between the deer and pig remains in elemental representation, specifically the near total absence of deer phalanges and the abundance of pig phalanges (Croft 2003d, 228). Croft suggests this pattern might be due to differences in processing or consumptive practice⁶.

The Mylouthkia sample permits the identification of sexual dimorphism in fallow deer. Sex identifications based on measurements of distal radii are compatible with the disproportionate culling of male deer at a younger age and greater survivorship into adulthood among female fallow deer (Croft 2003d, 230). This almost certainly reflects a hunting strategy sustained over many generations whereby female deer were allowed to survive and reproduce, increasing the amount of meat that could be sustainably culled. Study of mortality patterns among deer based on epiphyseal fusion provides support for the existence of this strategy, but also suggests that by the Middle Chalcolithic this strategy was changing. In Period 2, epiphyseal fusion data suggest about 9% of deer died as infants (<1 year) and 6% as juveniles (1 to 2 or 2.5 years), about 16% as sub-adults (2 or 2.5 to 3 or 3.5 years), and nearly 70% as adults (older than 2 to 3.5 years) (Croft 2003d, 229). Because so few of the deer remains

⁶ While several cultures avidly consume pigs' trotters, I know of no example of deers' feet being similarly favored as a delicacy.

belong to Final Period 2 and Period 3, these periods are combined in Croft's analysis. In these combined periods, more deer died in infancy (26%), relatively few juveniles (7%), 21% as sub-adults and 46% as adults.

These data reflect deer being culled at a younger age over time, as at Mosphilia (see below). Croft proposes that this shift is explained by “a concern to improve the productive efficiency of hunting” by taking deer shortly after their greatest weight gains in subadulthood (2003d, 230). Coupled, however, with a decrease in the overall contribution of deer to the meat supply and the intensification of animal husbandry, it suggests some pressure on deer populations in Mylouthkia's catchment, just as at long-lived village sites in the later Aceramic Neolithic.

A smaller sample is available for the analysis of epiphyseal fusion for pigs and caprines. In period 2, 30% of pigs died as infants (<1 year), 16% as juveniles (1 to 2 or 2.5 years), 15% as subadults (2 or 2.5 to 3 or 3.5 years) and 39% in adulthood (Croft 2003d, 230). Again, Final Period 2 and Period 3 are amalgamated, and Croft stresses their limitations. They are, however, within about 5 percentage points of those for Period 2, suggesting no great shift in the proportions of pigs slaughtered at different times, though perhaps a tendency to slaughter pigs at a slightly older age (Croft 2003d, 230). Because of the large number of pigs slaughtered as infants and juveniles, their preservation and recovery have probably been adversely affected; dentition, more durable than the bones of young pigs, suggests that many more were slaughtered at a younger age in Final Period 2 and Period 3 (Croft 2003d, 231). Based on size dimorphism, it would appear that most of the pigs slaughtered in adulthood

were sows, with males tending to be killed at younger ages (Croft 2003d, 232 and Figure 20.5). Croft also mentions the possibility that some of the bone on the site derives from hunted, feral pigs which would not necessarily be readily distinguished from domestic animals. A few individuals produced size measurements larger than modern wild boar (Croft 2003d, 232 and Figure 20.5).

Goats appear to have outnumbered sheep at a ratio of about 19 to 1 in the Early Chalcolithic (Croft 2003d, 232). The sample for this period is much larger (376 caprine bones, 120 identified as sheep and goat) than for Final Period 2 and Period 3, which together have only 11 identified as sheep and goat (Croft 2003d, 232). Horn cores reveal that the goats had “scimitar” horns. Epiphysial fusion indicates that in Period 2 about 7% of goats died as infants (<1 year), 14% as juveniles (1 to 1.5 or 2.5 years), 14% as subadults (from 1.5 or 2.5 to 2.5 or 3.5 years) and 65% in adulthood (Croft 2003d, 232). Again, teeth suggest that young animals are probably underrepresented, apparently by as much as a factor of three for the juvenile phase, though this might in fact reflect the *absence* of teeth from hunted adult goats, whose heads and foot bones, unlike those of kids, seem to have been removed in field butchery, since these elements are less common for goats than for pigs (Croft 2003d, 232-3). As at Kissonerga *Mylouthkia*, there appears to be a high survival rate into adulthood among males for a meat-oriented strategy, but some of these animals might be hunted feral goats (Croft 2003d, 234).

At least one proximal femur from a dog exhibits evidence of butchery, suggesting that canines may have been eaten (Croft 2003d, 234). Naturally, this does

not preclude other roles, such as their use in hunting, defending fields against animal predators, and as an “early warning” system for the settlement. Foxes were probably skinned for their pelts as well as their meat, and the same may have been true of cats (Croft 2003d, 234); both species probably helped to control the local rodent population. A single seal tooth (*Monachus monachus*) indicates either hunting or scavenging (Croft 2003d, 234). Identified bird remains all derive from flotation of a context especially rich in faunal and botanical remains (16.04, in Pit 16). All the identifiable bones belong to quail (*Coturnix coturnix*). It is likely that bird remains are severely underrepresented, with recovery outside of floated contexts on the order of 3% (Croft 1998, 212).

The fish remains from Mylouthkia are intriguing. They are few in number, but probably underrepresented relative to species with larger and more durable bones; additionally, fish may have been consumed off-site. The variety of fish represented includes bass (*Dicentrarchus labrax*), members of the Sparidae family (breams), sardines (*Sardina pilchardus*), horse mackerel (*Trachurus*), Moray eel (*Muraena helena*), and blue whiting (*Micromesistius poutassou*) (Cerón-Carraso 2003, 255-6). Cerón-Carraso argues (2003, 256) that these species represent at least three types of fishing behavior: inshore fishing with hook and line and perhaps harpoon for larger inshore species like horse mackerel and bass; offshore fishing for Blue whiting; and net fishing for small fishes like sardines.

The molluscs from the Chalcolithic occupation at Mylouthkia were analyzed by Ridout-Sharpe (2003b), who also studied the shells from the Cypro-PPNB wells

(2003a). Overall, limpets and topshells (*Patella* and *Monodonta*) predominate, 39% and 30% respectively (Ridout-Sharpe 2003b, Table 22.1). These species had been the main food species represented in the Cypro-PPNB deposits in the Mylouthkia wells. Their lower proportional contribution, and the greater number of species represented in the Chalcolithic compared with the Cypro-PPNB assemblage might suggest greater diet breadth and exploitation of lower-ranked species in the Chalcolithic. However, Ridout-Sharpe studied the size of the Neolithic and Chalcolithic limpets and found that the average size of the limpets in the Chalcolithic was slightly larger, suggesting that pressure from predation was actually lower in the Chalcolithic (Ridout-Sharpe 2003b, 248).

The giant tun (*Tonna galea*) was likely also a contributor to diet at Chalcolithic Mylouthkia (Ridout-Sharpe 2003b, 248). Its low numerical representation belies the large amount of meat that could be obtained from each individual. The dog cockle (*Glycymeris glycymeris*) was the most abundant taxon among the marine bivalves. Land snails such as *Helix* sp. may also have been eaten. Brackish water and freshwater snails might have been introduced along with drinking water or other products of an estuarine environment, such as reeds (Ridout-Sharpe 2003b, 250).

Ridout-Sharpe's analysis of the distribution of shells by context in the Chalcolithic settlement suggested that food species and non-food (e.g., beach worn) shells were found in the same contexts. These contexts also contained conch shells (*Charonia variegata*), which at Mosphilia (see below) may have had a ritual or other symbolic function; there is no evidence for any special use for them at Mylouthkia

(Ridout-Sharpe 2003b, 250).

Human remains belonging to at least 11 individuals, adults, sub-adults, and children, were recovered from the pits and buildings at Mylouthkia (Fox et al. 2003). Neither sexing, beyond two adults, one male and one female, nor stature estimates were possible (Fox et al. 2003, 221). Skeletal evidence for paleopathologies is minimal. Dental evidence for caries, one root canal, and mild enamel hypoplasia in an adolescent does not permit any statements about the effects of resource stress, if any, on the population.

The ground stone assemblage at Mylouthkia generally, with its numerous grinders, pounders, pestles, saddle querns and small oval querns, reflects the processing of plant foods on site, but also other activities (Jackson 2003). For example, nearly 60% of the querns are in sandstone: if used to process plant foods they would seem likely to have contributed an uncomfortable quantity of grit, and therefore they may have served some other purpose, such as the manufacture of other ground stone tools or grinding red ochre (Jackson 2003, 187). Since so little of the ground stone assemblage was found in situ, it is difficult to discuss the social aspects of food preparation.

The Early Chalcolithic ceramic assemblage at Mylouthkia contains several shapes suitable for storage of significant quantities of comestibles. These include storage jars, including an unusually high number of storage jar fragments from Pit 1 (Bolger and Shiel 2003, 143), some of the larger “holemouth” jars, and bottles (Bolger and Shiels 2003). However, most of the Early Chalcolithic ceramic shapes from

Mylouthkia are open forms, suitable for the preparation, presentation and consumption of food. Platters and trays are especially popular; bowls and deep bowls also occur in significant numbers (Bolger and Shiel 2003).

Domestic arrangements at Mylouthkia are ambiguous. Were above-ground structures and semi-subterranean ones used for different purposes? By different groups? Is there a seasonal aspect to their use? (Peltenburg 2003, 261-2). The phasing of Pit 1 suggests some subterranean features had long life spans, abandoned after the collapse of superstructure, used for rubbish or burials, repurposed and re-roofed (Peltenburg 2003, 262). As mentioned above, deposits from the pits included both grain-rich mixtures of chaff and cereal grains, and grains which had apparently been processed so as to remove chaff (Colledge 2003). Unlike the pits, Building 200 appears to have been little affected after the destruction of the building by fire (Peltenburg 2003). Its assemblage includes stone pot lids and jar stoppers, indicating that some storage vessels may have been kept in the house. Querns, rubbers, and pestles were also found inside the structure, from which Jackson reasonably infers indoor food preparation (2003, 187). Building 200 seems to follow the “standard” Middle Chalcolithic house plan, with a kitchen area opposite the entrance, with a living area, distinguished by an elaborated floor, on one side and areas for storage and working on the other: the querns are concentrated in the kitchen area (Peltenburg 2003, 268-71). Peltenburg compares B 200 to the traditional Cypriot *makrinari*, a single room area used for a multiplicity of activities, but in this case perhaps serving a kin group larger than a single nuclear family (2003, 271).

Artifacts and ceramic style at Mylouthkia both indicate contact with other communities on Cyprus—unsurprisingly, given the presence of others major Chalcolithic sites, Mosphilia, Lemba, and Chlorakas, from less than a kilometer to less than five kilometers distant. The procurement of different types of chert (McCartney 2003b), diabase, and picrolite attest raw material acquisition over a wider area than the agricultural catchment of the site. Coastal sites such as Mylouthkia may have had greater contact with one another than with more isolated upland sites like Politiko *Phournia* (Given and Knapp 2003, 225). The Skourotos earthworks at Mylouthkia, massive linear features now largely destroyed by construction activity, have been plausibly interpreted as defensive features and certainly represent the mobilization of a significant amount of labor in the Early Chalcolithic (Croft 2003e). The associated grave of an adult, head removed, interred with a quern, rubber, and stone vessel marked with red ochre (Croft 2003e, xxxi) suggests that some members of the community were more strongly associated than others with this feature. If defensive, the earthworks imply conflict, and the existence of mutually hostile groups. What contacts the people of Mylouthkia had with mainland groups remains unclear. There are only two pieces of obsidian possibly associated with the Chalcolithic phases at Mylouthkia; one a surface find and the other from a Period 2 context but possibly originally from the Aceramic Neolithic occupation (McCartney 2003, 211).

Data for the local environment of Mylouthkia and Skourotos derive primarily from the botanical and faunal assemblages reviewed above, the modern-day location and geography, reviewed in Chapter 3, and from investigations at other sites in the

Ktima lowlands. Held (1992) placed it in the same soil and vegetation zones as Lemba and Mosphilia.

KISSONERGA MOSPHILIA

The site of Kissonerga *Mosphilia* or *-Mosfilia* is located on the narrow coastal plain of western Cyprus, about 1 km from modern coast, 40 m asl, and just north of the Skotinis river. Held locates it within his climax vegetation zone 9: “Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy,” and in soil zones 2+10: “Interface of terra rossa on kafkalla; and alluvial soils” (Held 1992, 134). It lies in a zone typically receiving 400-500 mm of rainfall annually (Stanley Price 1979; Br. Admiralty 1923, 165).

The site has produced evidence of activity from the Late Neolithic through Early Bronze Age, ca. 4000-2300 BCE (Peltenburg 1982; Peltenburg 1991; Peltenburg 1998); the Neolithic pits have been addressed briefly in Chapter 4. The extent of the site has been estimated at 12 ha, four times larger than most sites of the period and twice as large as nearby Mylouthkia, but still smaller than Erimi *Pamboula* (Swiny 1989; Peltenburg 1991; Peltenburg 1998; Peltenburg 2003). The size and density of Mosphilia are likely to have changed over time. The spread of Early Chalcolithic material is considerably smaller than the 12 ha estimate, while there are no structures in the Main Area. In the Middle Chalcolithic (Period 3A), the settlement may have been as large as 8 ha, (Peltenburg 1998, 243 and Figure 16). Additionally, there is the

possibility of “intrasite drift” (Peltenburg 1991, 20), possibly related to the appropriation of some areas for special purposes or by groups wishing to differentiate themselves socially from the other inhabitants.

At the time of excavation, the site had been bulldozed to create agricultural terraces. Despite taphonomic processes acting on the site in antiquity, Peltenburg was able to identify occupation levels within structures and, with the assistance of ceramic typology, across the site (Peltenburg 1982a; Peltenburg 1998; Bolger 1998). For the Chalcolithic, we are concerned with two excavated areas at the site, the Main Area and Upper Terrace, and with stratigraphic periods 2, 3A, 3B, 4A and 4B. There is a good sequence of radiocarbon determinations from Mosphilia (Bolger et al. 1998). The excavators also published the original radiocarbon years BP, so these dates will be subject to recalibration with the most recent calibration curve, but I have used them to produce approximate dates:

Period 2 ca. 4000-3700 cal BC (roughly contemporary with Mylouthkia Period 2)

Period 3A ca. 3500-3200 cal BC (roughly contemporary with Mylouthkia period 3)

Period 3B ca. 3200-2800 cal BC (roughly contemporary with Lemba Period 1)

Period 4 ca. 2800-2400 cal BC (roughly contemporary with Lemba Periods 1-3)

Though the radiocarbon dates suggest a gap between Period 2 and 3A, this is not

borne out by the stratigraphy of the Upper Terrace, where Period 2 seems to have been immediately followed by Period 3A (see below). Overlapping radiocarbon dates for periods 3B and 4 as well as the site stratigraphy suggest no prolonged occupational hiatus (Bolger et al. 1998, 19).

In Period 2 there is evidence of timber-framed round structures on the Upper Terrace associated with storage pits (Peltenburg 1998, 25). No structures survive in the Main Area, but a variety of pits and a 1-m deep ditch or terrace exposed for a length of 5 m are indicative of activity in this area as well (Peltenburg 1998, 25). Period 3A saw the construction of more permanent structures on stone socles, some overtop old structures on the Upper Terrace and some in the Main Area. The Upper Terrace, however, seems to have been abandoned after Period 3A (Peltenburg 1998, 244).

Period 3B saw the construction of the “Ceremonial Area” within the Main Area – large round structures with plastered floors, one red, and walls; they also have separate rooms, not simply areas distinguished by internal features (Peltenburg 1998, 30). These are larger and more elaborate than the buildings of the “Stream Sector” further south. Peltenburg has argued for strong social differentiation between the “high sector,” including the Ceremonial Area, and the “Stream Sector,” based on structure size, burials or the absence of burials (from the high sector), the distribution of exotic materials and craft products, and representational art (1998). Found in the Ceremonial Area, in a pit beneath the wall of structure B 994, was a RW model of a Chalcolithic house, the interior walls of which had been “plastered” with light colored clay, and which contained eighteen small figures in stone and ceramic, a triton shell, and a

deliberately broken anthropomorphic vessel (Peltenburg 1989). The Ceremonial Area is often argued to represent asymmetric social relations, power aggregated by one kin group, associated with both craft production and ritual (Peltenburg 1998).

The intensification of asymmetric relationships by “aggrandizers” may have increased in Period 4, which saw the site expand to its greatest extent. The density of occupation was clearly uneven, with different structures in use at different times, but by Period 4, Peltenburg estimates (Peltenburg 1998, 254)—with many reservations—that the population of Mosphilia might have numbered anywhere from 600 to almost 2700 people, using different estimates for population densities in dry farming villages (Falconer 1994), and, alternately, cross-cultural studies of numbers of people accommodated by given areas of roofed space (Narroll 1962; Kolb 1985).

Period 4A also witnessed the construction of Building B3 in the central area, called the Pithos House after the number of large jars which it contained. It may have been an elite residence for people with access to hunted game, olive oil, and copper, or a focus for the mobilization and redistribution of various goods (Peltenburg 1998). This period also sees both variability and apparent social asymmetries in burial practice. Beginning in Period 4, communal burial in chamber tombs may have communicated lineage membership (Lunt et al. 1998, 84). The Pithos House was destroyed before the start of Period 4B, and a smaller round structure built atop it; at this time occupation of the site seems to involve several disparate zones, one with pairs of structures like those seen on the Upper Terrace as early as Period 2 (Peltenburg 1998, 251). Settlement continued at Mylouthkia into the Philia Phase,

understood to be transitional between the Chalcolithic and the Early Bronze Age in at least some parts of the island.

The plant remains from Kissonerga-Mosphilia have been studied by Mary Anne Murray (1998). The majority of the sample consists of residue from the separation of grain and chaff, and belongs to Periods 2-4 (Period 1A, the Aceramic, is represented by only one seed and is therefore not discussed in Chapter Three). In Murray's publication, plant species are presented according to their presence or absence in contacts selected for sampling by flotation (Murray 1998, Table 216). Murray argues that since plants were treated differently and some plant remains disposed of in fires or used as fuel, the numbers of seeds preserved would not be informative regarding the relative importance of the plants from which they derived (1998, 216). There were no obvious primary caches of seeds, carbonized or otherwise.

Present, then, over the whole of Periods 2-4, are *Triticum monococcum* and *T. dicoccum*, as well as bread or durum wheat (*T. aestivum/durum*), and barley (*Hordeum sativum*). Lentils are well represented throughout, as are *Vicia*, grape (*Vitis vinifera*), fig (*Ficus carica*), olive (*Olea europaea*), and Pistacia (Murray 1998, Table 11.1). Based on their size distribution, as well as the lack of any change in size over time, Murray concludes that a mixture of morphologically wild and domesticated lentils was exploited by the inhabitants of Mosphilia (1998, 217).

Hackberry (*Celtis* sp.), juniper (*Juniperus* sp.), peas (*Pisum sativum*), chickpeas (*Cicer arietinum*) and flax (*Linum usitatissimum*) are not as well represented, but occur intermittently. Like wheat and barley, these were probably

grown over winter and harvested in the spring. A large number of weeds typically associated with cereal crops and open fields, including oat (*Avena* sp.) are attested. Seeds of wild grasses were found in all contexts for Period 2, 95% of contexts for Period 3A, 69% of contexts for Period 3B, and 82% of contexts for Period 4 (Murray 1998, Table 11.1). These are likely to reflect wild grasses growing intermixed with cereal crops or perhaps gathered for fodder. Grass pea (*Lathyrus sativus*), for example, is important as animal fodder many places in Greece, though attested in only one context at Mosphilia; it is theoretically suitable for human consumption but needs to be processed to remove toxins (Halstead 1990, 153). Murray argues (220-1) that the weed species represented might reflect shallow tillage such as could be produced by cultivation with hoe or ard, tilling instruments which permit higher weed survival than deep plowing with draft animals.

Interestingly, Murray found more glume wheat chaff than grain for all periods, and an inverse pattern for barley. She suggests this might reflect the use of barley as fodder for domestic animals: it passed through animal digestive systems, if their dung burned as fuel, the barley grains would be carbonized and preserved (Murray 1998, 221). This would suggest a relatively high degree of affluence, if barley—more tolerant of bad conditions and more nutritious than wheat—could be fed to domestic animals under normal conditions. On Amorgos, for example, barley is grown as animal fodder but incorporated into human diet in bad years (Halstead 1990, 152-3). This representation of wheat and barley chaff and grains at Mosphilia further suggests that wheat and barley (or wheat-heavy and barley-heavy maslins) may have been

grown and processed separately.

While substantial quantities of charcoal were recovered from the excavations at Mosphilia, some almost certainly from beams within the dwellings themselves (Murray 1998, 222), these have not been subjected to intensive anthracological analysis. The potential of such analysis as a check on the paleobotanical assemblage and an additional source of information regarding the local environment is illustrated by the cases of Shillourokambos and Khirokitia (Thiébaud 2003).

There is limited evidence for spatial and temporal variation among the botanical remains at Mosphilia. Pit contexts from Periods 2 and 3A were richer in terms of seeds recovered per liter than later pit contexts (Murray 1998, 218). Rather than reflecting the primary contents of these pits, however, this probably reveals their tendency to accumulate sediments and to be used for the disposal of burned residue (Murray 1998, 218-219). The botanical assemblage from B 3, the Pithos House, is limited, adding support to the theory that many of the storage jars within may have been empty at the time of the building's destruction (Murray 1998, 219). Otherwise there was little spatial variation among the representation of species that might plausibly be related to processing, storage, or consumption (Murray 1998, 218-19).

There is no apparent change in the representation of emmer wheat as against other varieties by the percentage of contexts in which it appears, nor any change in the percentage of contexts in which barley was identified (Murray 1998, 218). Legumes, along with fruit and nut remains and wild grasses, are better represented in earlier contexts (2 and 3A) despite the higher number of contexts sampled for Period 4

(Murray 1998, 218). Period 3B represents a comparative dearth of samples relative to periods 2, 3A, and 4: Murray suggests this may be due to changes in either processing or the disposal of crop wastes (1998, 219). Changes in storage at this time might also be partly responsible. Period 4 exhibits the greatest diversity of species represented, but again, it also accounts for the greatest number of sampled contexts.

Therefore it would be at best tendentious to take these data as evidence of decreased diet breadth over time.

While no specific analysis of the charcoal from the site has been undertaken, some was assigned to species in the description of the samples (Bolger et al. 1998, 12-14).

Period 2: *Gramineae*

Period 3A: *Vitis vinifera*, *Lens*

Period 3B: *Pinus* (n=3), *Pinus/Olea*, *Morus* (n=3), *Lens*

Period 3/4: cf. *Pistacia*

Period 4: *Pinus*, *Pistacia*, *Pistacia/Pinus*, *Gramineae*, *Morus* (n=4)

(Bolger et al. 1998, 12-14)

The botanical assemblage from Mosphilia indicates a higher representation of weeds and arboreal species in contexts belonging to Periods 2-3A. However, this might reflect the higher yield of botanical samples generally from pits cut in those periods (Murray 1998, 218). Naturally, the fills do not immediately post-date the cuts,

nor were all the pits filled at the same time or according to the same taphonomic processes. Wet-loving plant species were present in 28% of sampled contexts in Period 4, as against only 12%, 8% and 5% of contexts for Periods 2, 3A and 3B respectively (Murray 1998, Table 11.1). Peltenburg, however, suggests that Periods 3B, with diversified crop residues, and Period 4, with a higher number of axes and adzes and a lower contribution of deer to the faunal assemblage, might have witnessed significant local environmental degradation, perhaps related to lower flow from the spring near the site, degradation which may have exacerbating existing social tensions (Peltenburg 1998, 255).

The faunal remains from Kissonerga *Mosphilia* have been studied by Paul Croft (1991, 1998, 2003d). Relative percentages of identified mammalian bone fragments for the site as a whole are indicated in Table 2. Rodents and single examples of hippopotamus, equid, cetacean, and seal have been omitted. Cattle bone in Chalcolithic contexts is likely to be intrusive (Croft 1998, 211)

For deer, epiphysial fusion data reveal a culling pattern similar to Aceramic Neolithic Khirokitia and Tenta: very few infant deer were taken (8%), rather more (24%) juveniles (1 to 2 or 2.5 years) and about 12% subadults (2 or 2.5 to 3 or 3.5 years), while just under half of all deer were taken in adulthood, after 3 or 3.5 years (Croft 1998, 209). The overall number of deer taken in the juvenile and subadult stages, soon after their maximum weight gain, is very closely comparable to Neolithic Tenta, where from 28% (epiphysial fusion) to 45% (teeth) of deer were killed as juveniles or sub-adults (Croft 2005, 350). Croft argues, however, that the data from

Mosphilia tentatively support a change in culling practice over time in Periods 3 and 4, with more deer culled at the juvenile stage, and fewer at the subadult stage (Croft 1998, 209). This coincides with a drop in the overall contribution of deer from nearly 70% of the meat supply at the site in the Early Chalcolithic (taking weight and differential recovery into consideration) to 38% by the Late Chalcolithic (Croft 1998, Table 10.3).

For pigs, epiphysial fusion data as reported by Croft (1998, 209) indicate high mortality in the infant (<1 year) and juvenile (1-2.5 years) stages, 39% and 9% respectively. 25% were slaughtered as subadults, from 2 or 2.5 to 3.5 years, and 17% in adulthood (> 3 or 3.5 years). The pattern clearly reflects a focus on meat production, taking advantage of the quick weight gains made by younger animals (Croft 1998, 209). However, change in the age profiles over time is apparently the reverse of that for deer, with fewer juveniles and more subadults slaughtered in Period 4. Pigs steadily increased their contribution to the meat supply, from perhaps 24% in Period 3A to 54% in Period 4 (Croft 1998, Table 10.3).

Ovicaprids, of which 88% of identifiable fragments belong to goat and 12% to sheep, exhibit a different pattern. 19% died as infants (< 1 year), 12% as juveniles (1 to 1.5-2.5 years) 15% in subadulthood (1.5 or 2.5 to 3 or 3.5 years) and 54% in adulthood (> 2.5 or 2.5 years) (Croft 1998, 209). Significantly, adult specimens reveal a nearly equal proportion of adult male and female goats, with sex based on size measurements (Croft 1998, 210). Such a pattern, with high energetic costs relating to the maintenance of superfluous male animals reflects neither optimal production of

meat nor milk production, and Croft suggests that either some of the male goats were feral and hunted, or perhaps the ownership of horned males was somehow socially significant (1998, 201). Caprines consistently may have contributed between about 6% and 9 % of the meat consumed at Mosphilia, by weight.

The cattle remains from Mosphilia come primarily from Period 5, the Philia occupation. Those Period 4 (Late Chalcolithic) contexts which do have cattle bone are recognized by the excavators as contaminated (Croft 1998, 211). Croft notes that despite the presence of dog, bones of quadrupeds do not exhibit damage consistent with gnawing or chewing by canines (1998, 211). Fox are represented by a whole range of skeletal elements and were therefore apparently skinned on site, presumably for their pelts (Croft 1998, 211).

Bird remains consist predominantly of pigeons, with some ducks, quail, thrushes, and jay (Croft 1998, 212). Owl, crane and vulture may also be represented, though these single specimens are not positively identified (Croft 1998, 212). Based on flotation, Croft estimates that the bird remains recovered constitute perhaps 3% of those that were actually present, the “tip of the avian iceberg” (1998, 212). While birds as hunted game are considered among the lowest “ranked” resources in terms of expected return on energy in calories, where they can be taken in large numbers with simple or durable technology such as nets, quick lime, or nooses, they become a viable food resource. And under conditions of stress, even a wood pigeon -sized bird is a meal.

Croft's analysis found no significant difference between animal bone

assemblages from pits and graves and that from the site overall. Buildings, however, often had assemblages which were very different from the period overall (Croft 1998, 213). The Pithos House had a high percentage of deer remains, while in the contemporary building B 706 caprines were disproportionately represented and in B 866 pigs were more prominent (Croft 1998, 213 and Table 22.12). The implications of the assemblages from these structures are discussed below.

The fish remains from Mosphilia were studied by Brian Irving (1998). Taphonomic processes contributed to the poor preservation of much of the fish bone, and it may have been subject to extremely poor recovery, like bird bone (Croft 1998). The most common taxa identified were herrings and sardines (*Clupidae* and *Sardina pulchardis*), followed by bream (the *Sparidae*), Grouper (*Serranidae* and *Epinephalus*, the tsipoura), three gurnards (*Triglidae* fam) and single examples of parrotfish (*Scarus* sp.), mackerel (*Scomber scombrus*), mullet (*Liza ramada*) and john dory (*Zeus faber*). The sample size is too small, and taphonomic processes too severe, to put too much weight on the relative representation of these taxa or changes in their representation over time, or to identify cleaning practice. According to Irving, these species are all present in the littoral zone (Irving 1998, 232) and none represent deep-water fishing.

The marine invertebrates from the site were studied by Jane Ridout-Sharpe. Many were recovered in flotation, reinforcing the importance of this procedure for environmental studies of all kinds. Here as with all sites within a short distance of the coast, it is entirely possible that the inhabitants of Mosphilia consumed large numbers of shellfish off-site, redepositing shells in the sea or leaving middens on the beach

which have been destroyed or escaped attention.

Limpets (*Patella*) and topshells (*Monodonta*) are by far the most commonly represented taxa, at 28% and 26% of the assemblage respectively (Ridout-Sharpe 1998, 224). Most of the topshells had been smashed, though small ones had apparently simply been discarded, and limpets showed evidence of having been pried off the rocks to which they had been attached (Ridout-Sharpe 1998, 225). Sharpe argues that the low mean size of the Patellidae recovered at the site indicates that local populations were overexploited, with individuals not allowed to attain maximum weight before being harvested (1998, 225). Most limpets and topshells derive from periods 3B and 4, possibly suggesting an increase in diet breadth at this time. However, this number is skewed by the 99 of the topshells, mostly small, which were found in the “cult pit” in the Ceremonial Area, perhaps as an offering (Ridout Sharpe 1998, 225). *Columbella rustica*, the dove shell, was the third most common taxon at 10% of the assemblage (Sharpe 1998, 226). *Charonia* are also represented; these may have had some ceremonial significance (Sharpe 1998, 225). Many smaller shells may have been used primarily as ornaments, including *Dentalium*, *Galeodea*, and others (Ridout-Sharpe 1998, 226).

Among the bivalves, very few seem to have been collected as living specimens: shells are generally beach-worn and abraded and may have been picked up for their visual interest, for use in personal ornaments like those found in some burials, or for some other reason (Ridout-Sharpe 1998, 227). Dog cockles (*Glycymeris glycymeris*) are by far the most common. Of those which might have been eaten fresh,

scallops (*Pecten jacobaeus*), cockles (*Ostraea edulis*), and mussels (*Pinna nobilis*) are all represented in small numbers. Sea urchin spines, crab, prawn, and lobster claws, attest to the exploitation of these species too (Ridout-Sharpe 1995, 228).

Numerous land and freshwater snails were also recovered. While some are likely intrusive, others may have been on the site in antiquity. The range of species includes both those which prefer a dry, open environment, and aquatic species which may have been brought from nearly riparian or marsh environments, possibly along with vegetation such as reeds, or with drinking water, as suggested by Ridout-Sharpe (1998, 229). High numbers of land snails deriving from pits and graves might suggest that these contexts remained open for some time (Ridout-Sharpe 1998, 229).

Mosphilia presents intriguing evidence for change in storage practices over time, worth examining in some detail. Already in Period 2 there is evidence for large scale storage adjacent to the round timber-framed structures like B 5147 on the Upper Terrace (Peltenburg 1998, 24-5). It is not always possible to determine which pits belonged to Period 2 and which to the succeeding Period 3A, but the cuts of the pits to the north of B 1547, the earliest Period 2 structure, are for the most part contemporary with this Early Chalcolithic structure (Peltenburg 1998, 24). Period 2 pits are mostly bell-shaped and interpreted by the excavators as consistent with grain storage, though no evidence of their original contents remains (Peltenburg 1998, 25). Bell-shaped storage pits have been argued to inhibit grain sprouting, and were used in antiquity and in the early modern period on Cyprus to store grain (Reynolds 1974, Krestos 1956). The Period 2 pits at Mosphilia contained later fill (from period 3A) of

unworked stones, ground stone tools, and varied in size from 2.5 - 4.6 m³ (Peltenburg 1998, 25).

Peltenburg has estimated that the aggregate capacity of the excavated pits belonging to Period 2 was about 10.5-16 m³, which, depending on a myriad of other factors including but not limited to the contemporaneity of the pits and the relative importance, could have held sufficient quantities of wheat or barley to help sustain about 20-50 people for a year (Peltenburg 1998, 241). Since many archaeologists now have a tendency instantly to dismiss numbers such as these out of hand based on their ability to recognize or invent possible sources of error, it should be stressed that Peltenburg recognizes full well that these are numbers for thinking with, not an empirical determination of the Early Chalcolithic population of the site.

Peltenburg, using Kolb's (1985) and Narroll's (1962) estimates for floor space per person, derived from a large set of ethnographically observed cases, further argues that twenty to fifty people might have required from 10 to 27 structures the size of B 2180—many more than were documented for Period 2 (Peltenburg 1998, 241). Obviously, these 20-50 people cannot be taken as an estimate of the maximum or minimum size of the settlement, since the pits might not all have been full at once, there might well be other pits elsewhere, and other methods of storage might have been employed. Indeed, the number and volume of the pits give virtually no information whatsoever about the likely size of the settlement. What is significant is the spatial concentration of storage facilities that can reasonably be taken to have supported more than the likely occupants of a single structure.

Still more interesting are the implications for site catchment. Using Marfoe's (1979) estimate of 300 kg of grain for 1 ha for plough agriculture in semi-arid zones, and Christodolou's (1959) estimate for weight and volume based on historical record, Peltenburg suggests the storage capacity of the Period 2 pits might reflect as much as 25-50 ha given over to the cultivation of cereals, implying extensive land clearance and potentially significant anthropogenic erosion (1998, 241). Mosphilia is not only a large site, but in close proximity to several other large and apparently contemporary sites (see below), creating potential conflict over agricultural land.

In Period 3A, pits come in different sizes and shapes. The fact that they are neither so uniform in design as those of Period 2 nor so numerous may reflect the increased use of ceramic forms for storage (Peltenburg 1998, 243). Over 90% of the ceramic forms for Period 3 are closed shapes, suggesting that storage might have been a major function of the ceramic assemblage (Bolger et al. 1998, 105). Some of these Period 3A pits are undoubtedly contemporary with structures on the Upper Terrace, which were built above and consistent with the location of earlier Period 2 structures (Peltenburg 1998, 24). Others occur in the Main Area. At this time, the “communal” pit area on the Upper Terrace was “assimilated” by a building, Structure 1547.

It is in Period 3A that Peltenburg argues that previously communal storage was “privatized,” exemplified by the construction of building B 1547 over and adjacent to older features interpreted as storage pits (1998, 242). Bolger has noted, however, a general lack of storage vessels before Period 3B (1998, 125). Period 3A ceramic assemblage contains a large number and variety of small bowls (Bolger 1998). Period

3A pits plausibly interpreted as storage features appear to have been located mostly outside structures (Peltenburg 1998, 26). It is also during this phase that burials adjacent to the external walls of houses appear (though some burials are not associated with structures) which Peltenburg takes as evidence for a system of inheritance and property rights (1998, 243). Peltenburg has also argued that the increasing use of field stone in structures also implies the construction of terrace and field walls, thus accounting for the lack of evidence for erosion (1998, 242, 244). Currently in the Mediterranean, such features often serve to demarcate plots to which individuals or kin groups have ownership claims as much as to halt erosional processes.

Period 3B saw the first major construction in the Main Area, including the exceptionally large and elaborated structures of the Ceremonial Area around a central courtyard (described in Peltenburg et al. LAP II.2). Several of the Ceremonial Area structures contained storage jars of significant size (diameter > 30 cm), and in the central court were found fragments of pithoi and 17 stone lids in the central court (Peltenburg 1998, 31).

Significantly, it is in Period 4 that the large holemouth jar and collared storage jar make their appearance, suggesting the necessity for increased large-scale storage of liquids (Bolger 1998, 98). The jars found inside the Pithos House would have provided somewhere in the neighborhood of 4000 liters of storage capacity, according to calculations by Peltenburg and Bolger (Peltenburg 1998, 254). There is no conclusive evidence for their contents, but the pithoi in Area 1 of the structure alone could have furnished 100 people with 15 liters each for a year (Keswani 1993, 77). If

all the jars Bolger has identified as liquid storage were filled brim-full with olive oil, they would represent a reserve of 3200 liters, or 32 liters for each of 100 people. Using 8000 calories/liter, this quantity would represent 256,000 stored calories or 700 calories/day for a year.

The Pithos House also contained vessels which Bolger has argued probably served for dry storage: several storage jars with capacities of about 25 liters, and four barrels with capacities from 150-200 liters (Bolger 1998, 128). The contents of these vessels have not been established. Indications are that many of the vessels in the Pithos House may have been empty, with some jars stacked atop others, at the time of its destruction, which Peltenburg attributes to a sudden accidental fire or deliberate destruction, perhaps after the death of a senior adult (1998, 253).

Important evidence for food preparation, presentation and consumption at Mosphilia comes from the layout of structures, whose floor plans reveal strongly patterned spatial divisions corresponding with activity areas, and from assemblages on the floors of these structures, which include ceramics, ground stone, faunal material, and fragments of ovens. It would be both tedious and redundant to fully describe all this material here, since it is presented at length in several publications (Peltenburg et al. 1991; Peltenburg et al. 1998). However, a few key points should be highlighted.

Peltenburg has argued (1998, 240-1) that while the Period 1 pit structures on the Upper Terrace may have been used for sleeping, eating, and working, food processing and cooking probably took place outside. Given the concentration of storage pits in the area, he further suggests that “out-of-doors food processing and

storage was a communal activity” (Peltenburg 1998, 240). The Period 2 ceramic assemblage includes a variety of small and medium bowls (Bolger 1998) which would have been suitable for individual meals, or for containing different dishes in a communal setting. Platters and trays of various kinds, small and medium-sized bowls, and are present in Period 2 and continue through Period 4 (Bolger 1998).

From Period 3A onwards, there is strong patterning in the interior spatial organization of buildings at Mosphilia, which is also reflected in the house model from the Ceremonial Area (Peltenburg 1998, 237). Structures are generally round, though there are also a number of small rectilinear structures like 1295, 1161, and 1000. Hearths are centrally located. Doorways are often, but not always, located on the southern side; exceptions include the Period 4 Basin Building, with a NW doorway; this may not have been a domestic structure. At least one segment of the house, a radial slice out from the central hearth and often the western or south-western part, is set off from the rest of the building by low raised dividers. The floor of this section is always treated differently, sometimes simply highly compacted, sometimes plastered; one example is pebbled. Storage of food was adjacent to cooking areas in the segment furthest from the door. Cooking took place at the central hearth as well as in earth ovens (Peltenburg 1998, 237-40), while the ceramic assemblage is dominated by small bowls, decorated in styles which to Bolger (1998) appear to be identified with particular households.

In Period 3B, the spatial organization of houses remained similar to that in 3A, though there are more of them and some are more elaborate (like those structures in the

Ceremonial Area). Hearths changed from circular to rectangular, a trend begun in structures on the Upper Terrace in period 3A (Peltenburg 1998, 243). Cooking activities continued generally to take place indoors, along with some processing, as in Ridge Building 855, where mortars and querns are associated with a subdivided basin in the western part of the structure and pieces of a ceramic oven in the northeast (Peltenburg 1998, 33). Also recovered from this building, which may have been suddenly destroyed, were several discrete groups of pottery from the hearth area: basins, flasks, and a large number of bowls (Peltenburg 1998, 33-4). In 3B, the ceramic assemblage is argued to contain many more “presentation” vessels, large open shapes with decoration, and this is especially true of the buildings in the high sector. Decoration continues to be suggestive of household-level production (Bolger 1998; Peltenburg 1998, 252). Stone bowls may also have served as presentation vessels. The large Red Building (B 206) contained a large assemblage of such serving vessels and may have hosted feasts of some kind (Peltenburg 1998, 247).

While ovens are often found adjacent to the hearth and living spaces of houses, at least one was found in situ in one of the re-used small rectilinear structures in the Main Area, B 1161 (Peltenburg 1998, 243). The open central space in the Ceremonial Area contained a large number of ovens, constructed at the same time the building model was interred in this area, perhaps as part of a communal consumptive event related to closing one of the buildings, like Building 206, which alone of the excavated structures at Mosphilia has a red floor, like the model (Peltenburg 1998, 248). This ritual may have come very near the end of the 3B phase (Peltenburg 1998,

249).

The number of artifacts characterized by the excavators as “food preparation equipment”—grinders, querns, etc.—drops significantly from Period 3A to Period 3B, despite the larger size of the settlement and more structures associated with the latter period, only to increase again in Period 4 by a factor of more than 4 over period 3B (Peltenburg 1998, 244). Many artifacts of ground and chipped stone were apparently deliberately discarded while still in perfectly useful condition, while caches of stone tools, mostly notably in the Pithos House but also in other structures, regularly occur (Peltenburg et al. 1991, Peltenburg 1998, 235).

There appears to be something of a hiatus between the end of Period 3B and the first buildings of Period 4A, the Pithos House among them (Peltenburg 1998, 249). This structure represents a remarkable concentration of material wealth of all kinds. Certain types of commodities may have been stored in discrete areas in the building, to judge from the locations of the ceramics recovered, with the areas near the hearth also showing evidence for food preparation and presentation vessels (Bolger 1998). The possible olive press suggests at least some of the processing may have occurred in the building itself; it did not serve simply to store mobilized resources (Peltenburg 1998, 252).

The common ceramic wares of 3B are both replaced in Period 4 by RB/B; decoration disappears, replaced by monochrome finishes, with an end to individual household styles; stone bowl production decreases and becomes more perfunctory. There are massive storage vessels (Peltenburg 1998, 251-2). According to Bolger,

“The increasing diversity of morphological types points to increasing need for a greater range of functions for food preparation, storage and cooking and may ultimately stem from growing levels of sedentism, division of labour and craft specialization” (1998, 145).

The bowls and hemibowls from the Pithos House seem to occur in standardized volumes from 1-4 liters at 0.5 liter intervals (Bolger 1998, 128). This strongly suggests the distribution of standard quantities, perhaps as rations. Meanwhile, gas chromatography indicates that some smaller vessels, especially bowls, were treated with beeswax, probably to enhance their liquid holding capabilities (Quye and Ritson in Bolger 1998, 127-141). The big holemouth jars were not so treated, leading Bolger to suggest (1998, 128) that they may have been used to store water, since evaporation through the untreated sides of the vessel would keep the contents cooler.

In Period 4B, after the destruction of the Pithos House, Peltenburg has argued for economically independent compounds, weakly integrated, with the whole settlement much less hierarchically organized than in 4A (1998, 250-1). There are no “public works” like the paved track in the Main Area in Period 3B. There are no outdoor ovens associated with this phase, and food preparation and consumption seem to have taken place primarily indoors, as in the Basin Building (Building 1046), with querns adjacent to the eponymous basins (Peltenburg 1998, 251, 254). Both ground stone and chipped stone tools became more numerous, larger, and more various in Period 4, suggesting to Peltenburg, in combination with faunal evidence and evidence

for storage, that agricultural production was intensified in this phase (Peltenburg 1998, 254).

There is a rich mortuary record from Mosphilia Periods 3 and 4, comprising 73 inhumations of all ages from infants to adults, in addition to quantities of human bone recovered out of context. This record is not analyzed here for evidence of social distinctions and inequality, change in gender roles, or symbolic practice—these arguments have been made elsewhere (Niklasson 1991, Bolger 1994, Lunt et al. 1998)—but for evidence of subsistence practice and resource stress. Nevertheless, several points bear reiteration. The excavators have commented on a “surprising diversity of inhumation rites” (Lunt et al. 1998). Such diversity is likely to reflect both social change and, at some periods, lack of strong social consensus regarding social roles and the proper treatment of the dead (O’Shea 1996). The frequency of burials in close proximity to the living sectors of houses has already been mentioned. Apart from this, spatially circumscribed burial groups are rare: the Mortuary Area in Period 4 represents the only convincing such group (Peltenburg 1998, 46). At some points, some individuals, especially adults, may have been interred in as yet undiscovered extramural cemeteries. The preservation of skeletal material was generally poor, so much of the analysis of the physical remains concerns dental development and pathologies.

The dead population, aged by tooth development, appears to reflect very high neonatal, infant and juvenile mortality (Lunt et al. 1998). Juveniles (<20 years) comprised 87% of the sample in Period 3 and 56% in period 4 (Lunt et al. 1998, 74-5

and Table 4.3). The sample is even more heavily weighted towards infants and children (below 6 years), which accounted for 73% of the sample in Period 3, 75% in contexts assigned to either Period 3 or 4, 28% in Period 4, and 100% in contexts of Periods 4 or 5.

These results are closely comparable—within a few percentage points—to the age category distribution in the dead population at Lemba (Lunt et al. 1998, 75 and Table 4.4), suggesting either that deposition of adults outside the settlement was common to both sites, or that both had a very high child mortality rate. Given the small sample size for Periods 3A and 3B and the absence of data for Period 2, it is difficult to make any convincing argument about diachronic change in mortality by age groups.

As at Khirokitia (Angel 1953), molar wear was generally lower than in some other prehistoric populations, though one mature adult woman had extremely worn teeth and had lost her lower molars possibly as a result of periodontal disease, while three adults from Period 4 exhibited very worn first molars (Lunt et al. 1998, 76-77, 80). The incidence of caries at Mosphilia was about 1.8% overall, as compared with 2.3% for Khirokitia and 5.3% at Lemba Lakkous (Lunt et al. 1998, 78-9). Incidence of caries was higher in adults than juveniles, the reverse of the pattern observed at Lemba *Lakkous* (Lunt et al. 1998, 78). It is the opinion of the investigators that this might reflect a difference in diet, with the inhabitants of Lemba more reliant on cereal agriculture and those of Mosphilia on hunted meat and wild plant foods (Lunt et al. 1994, 79). This proposition is impossible to resolve conclusively, but is examined

below in the second part of this chapter.

Enamel hypoplasia, a possible indicator of malnutrition (but also of sudden severe stress from, e.g., illness) was observed in several individuals, though none of the cases was severe (Lunt et al. 1998, 81). The populations of Lemba, Mosphilia, and other Chalcolithic sites in Cyprus exhibit taurodontism, short molar roots, at rates much higher than modern populations, and there is a variety of other dental pathologies, but few if any can be definitively linked to resource stress (Lunt et al. 1998).

A group of nine individuals, five adults and four children tentatively identified as members of a kin group, all suffered from thalassemia (T. 505). This group was interred together in the Mortuary Enclosure, a group of graves and tombs which was set off from the settlement by a wooden palisade, attested by post holes, in which palisade there was an entrance marked by an elaborated rectangular platform (Peltenburg 1998, 46; Lunt et al. 1998, 88-9). One of the children may in fact have died from thalassemia (Lunt et al. 1998, 88).

Evidence for external contacts at Mosphilia comes in the form of picrolite, procured from the Kouris river valley in Cyprus, chert and obsidian obtained from sources in Cyprus and Central Anatolia, aspects of ceramic style, and certain changes in technology and behavior thought to have Anatolian analogues. In Periods 2 and 3, ceramic production remained at a community, if not a household level, but there are strong similarities with ceramics at other nearby sites like Mylouthkia (Bolger 1998, Bolger and Shiels 2003). On the other hand, Peltenburg has argued that the

introduction in Period 4A of a suite of material cultural items including items of personal dress including annular shell rings, ceramic wares, shapes, and decorative features, artifacts interpreted as stamp seals, and new forms of burial, all prefigure the Philia phase and all probably reflect increased contact with Anatolia (1998, 256-8). It is also at this time that copper working expanded beyond the few small fishhooks and plaques known from earlier contexts at Mylouthkia and Erimi (Gale 1991, Croft and Peltenburg 2003).

Given the size of the settlement, it is important to consider the possibility that within Mosphilia there are represented different communities with different backgrounds and belonging to different regional kinship networks. The range of possible responses to periodic stress would have been different for people depending on the range of their kinship and affinal ties.

SOUSKIOU LAONA

The cemeteries at Soukiou *Vathykakas* and an associated settlement at Soukiou *Laona*, some 2.5 km inland from the modern village of Kouklia and at approximately 150 meters asl (see map, Figure 12, above), have been recognized as important sources of material since the early days of Cypriot prehistoric archaeology. These have most recently been investigated by the Canadian Palaipaphos Survey Project (Rupp et al. 1992) and the Lemba Archaeological Research Center (Bolger et al. 2004, Crewe et al. 2005, Peltenburg et al. 2006). Held places Soukiou *Laona* in climax vegetation zones 5+8: “Interface of Western Upland Forest of Cyprian Oak and

Hermes Oak on limestone and Mamonía Complex; and Maquis of Carob and Lentisk, replaced below 350 m asl. by Maritime Scrub Forest of Lentisk and Common Cyprus Juniper with or without Carob and Wild Olive under localized Aleppo Pine canopy,” and soil zones 2+10, “interface of terra rossa on karkalla, and alluvial soils” (Held 1992, 140). The site lies in a zone tending to receive 400-500 mm of rainfall annually (Held 1992, 140). While no detailed environmental data are yet available from these sites, it is nonetheless worth considering Laona briefly.

The settlement may be some 2.2 ha in size (Peltenburg et al. 2006, 84), considerably smaller than Moshilia's 12 ha., though at both sites different areas appear to have been occupied or abandoned at different times. Laona is not yet securely dated, but may be Middle to Late Chalcolithic; it has produced an unusual type of Red-on-Red pottery (Rupp et al. 1992). Limited excavation has so far revealed structures with curvilinear stone walls similar to those identified at Moshilia (Peltenburg et al. 1998, 55). One of these, Building 69, appears to lack the internal divisions characteristic of Chalcolithic houses at other sites, and is thought based on the large number of stone tools found inside to be some sort of workshop (Peltenburg et al. 2006, 95). Another building, B 34, contained a great deal of broken pottery and an in situ mortar, held in place by packing stones (Peltenburg et al. 2006, 98). A later pit contained a number of copper objects, which date among the earliest on Cyprus: there is some speculation that this pit and the fill of an ashy layer containing a figurine and dentalium shells might represent redeposited mortuary material (Peltenburg et al. 2006, 98). The ceramic chronology is still being worked out, but as elsewhere, early

Middle Chalcolithic ceramics include few storage jars (Peltenburg et al. 2006, 100).

Peltenburg and other investigators have argued that Laona's position at the lower end of the Dhiarizos River valley and on a possible east-west route. Picrolite, which can be picked up in the Dhiarizos valley in large nodules, was extensively worked at the site, and used all over Cyprus for the manufacture of small figurines and artifacts interpreted as personal ornaments, which may have played a significant role in symbolic behavior (Peltenburg 1982b; Xenophontos 1991).

Laona is likely to be contemporary with the Ceremonial Area and the Pithos House at Mosphilia (above). No such architectural elaboration has been revealed by the excavations at Laona, but at the associated cemetery of Souskiou *Vathykakas*, where a diverse set of mortuary practices are represented (Crewe et al. 2005), the large and elaborate tomb T.73 is suggestive of emerging inequality in the ritual and mortuary sphere. Such inequality in the ritual and mortuary sphere may, however, have been checked by egalitarianizing mechanisms in other arenas of social life (Peltenburg et al. 2006).

The large dead population from *Vathykakas* (Lunt 1994; Lunt et al. 2006) should be highly informative regarding the general state of health of Chalcolithic populations (cf. Harper and Fox 2008). However, there are several complicating factors. First was the prevalence of multiple burial, such that human remains deposited at different times became mixed. Second is disturbances caused by looting. Third, post-mortem damage to both teeth and bone were so severe as to render both categories of evidence abraded, fragmentary, and extremely difficult of interpretation

(Lunt et al. 2006).

Evidence of the age structure of the dead population at Vathyrkakas according to tooth and bone data is as follows:

Age structure based on teeth

0-5 years n= 26 = 12.6%

6-12 years n= 9 = 4.4%

13-19 years n= 13 = 6.3 %

17-25 years n= 9 = 4.4%

child/adolescent n= 2 = 1%

adolescent n= 5 = 2.4%

adolescent/young adult n= 6 = 2.9%

20-25 years n= 28 = 13.6%

25-35 years n= 35 = 17%

young adult n= 6 = 2.9%

mature adult n= 10 = 4.9%

elderly n= 4 = 2%

adult n= 14 = 6.8%

possible adult n= 19 = 6.8%

total n = 206

Age structure based on bones

<1 year n=7, = 3.7%

1-6 years n= 11 = 5.9%

7-12 years n= 13.1 = 7%

13-18 years n= 22.2 = 11.8%

19-30 years n= 65.9 = 35.1%

31-45 years n=58.2 = 31%

46+ years n=10.5=5.6%

(Lunt et al. Table 4.2 and 4.4)⁷

Given the poor preservation affecting both categories of evidence, the two data sets might be said to be in rough agreement. For example, people under about 20 years of age account for approximately 34% of the Vathyrkakas dead population using teeth, and 28 % of the population using bones. Young bones may have suffered poorer preservation than young teeth (assuming of course that deciduous teeth from living individuals are not represented in burials). Both sets of figures are both significantly lower than those from Lemba and Mosphilia, where juveniles were 71% and 72% of the dead populations, respectively (Lunt et al. 2006, 49). The most probable *prima facie* explanation would seem to be a functional difference between settlement sites, at

⁷ I have used Lunt et. al's 'B' population estimate including 19 additional adults, and SV-2, the osteological data set including 18 additional individuals. Age ranges used for age categories for dental

which more juveniles were buried, and cemeteries, where more adults were buried, rather than drastically different mortality curves for the three putative populations. Differences in preservation between Vathykakas and the settlement sites may also have affected the proportional representation of juveniles and adults.

Caries were identified in either 32 or (including some badly damaged and therefore inconclusive teeth) 37 of the 1351 permanent teeth recovered, amounting to either 2.4% or 2.7% (Lunt et al. 2006, 49). This percentage is higher than that observed at Mosphilia (1.8%), though about the same as Mosphilia Period 4 (2.3%), and much lower than that observed at Lemba (5.3%), this despite the fact that many more adults and mature adults, who might be expected to have more cavities, were represented at Vathykakas than at Lemba or Mosphilia (Lunt et al. 2006, 50). Rather than a significant difference in diet or oral hygiene, this may be attributable to the poor post-mortem preservation of the teeth at Vathykakas, leading to systematic underestimation of the incidence of caries.

Other pathologies and anomalies identified included impacted molars and the exposure of pulp in teeth with severe caries, which would have led to infection and dental abscesses or cysts, evidence for which was also observed in jaw fragments (Lunt et al. 2006, 50). Preservation interfered again with the assessment of periodontal disease, but Lunt et al. argue (51) that it probably accounts for some of the observed reduction in the height of alveolar bone. Based on jaw fragments, in vivo tooth loss was estimated at around 7-8.4% (Lunt et al. 2006, 51). Taurodontism, a variation in

analysis (e.g. juveniles and young adults) overlap.

the formation of molar roots, occurred in around 35.6% of molars that were sufficiently well preserved to allow examination (Lunt et al. 2006, 52).

Unfortunately, the preservation of the teeth was too poor to allow for the identification of enamel hypoplasia. The high prevalence of “shovel-shaped” second maxillary incisors (58%) may reflect a correspondingly high incidence of thalassaemia, though lower than the rate of shoveling observed at Mosphilia and Lemba, 76.5% and 72.7% respectively (Lunt et al. 2006, 51). It should be noted that the former two sites occupy coastal positions, while if the Vathyrkas cemetery served primarily the population of Souskiou-Laona, situated inland and on a breezy ridge, and perhaps other inland sites, mosquitoes and thus malaria may have been less of a problem.

Turning to the osteological evidence, Zissis Parras, who studied the bones, believed too few well-preserved bones were recovered for the secure identification of pathologies. He estimated average mortality for adult males at 30.7 years and for adult females at 32.9 years (Parras in Lunt et al. 2006, Table 4.7). These values are roughly comparable with those from contemporary sites in southwestern Cyprus: 33.3 and 34.9 years at Mosphilia, 34.9 and 27 years at Lemba, 33.8 and 29.8 years at Kissonerga-Myliouthkia. Many differences among the sites may result simply from the fact that these age estimates are based on small samples and often poorly preserved bones. However, it is interesting to note that Vathyrkakas is the only site with greater average female than male longevity. Unfortunately it cannot be determined whether this correlates with the much lower representation of infants and young children (i.e.,

fewer deaths in childbirth for mother and child) given the systematic underrepresentation of infants and children in the first place at Vathyrkakas.

Based on seven fragmentary lower long bones, Parras made estimates for stature of living individuals: 151 cm, 144 cm, 168 cm, 170 cm, 151 cm, 147 cm, and 155 cm (Parras in Lunt et al. 2006, 61). These values give an average of 155 cm, and reflect a substantial difference between males and females. Parras' estimates for height for males at other sites in southwest Cyprus range from 166-176 cm and average 169 cm; his estimates for women range from 150-154 cm and average around 152 cm. In short, the average stature for men and women at Vathyrkakas seems to have been comparable with Lemba, Mosphilia, and Mylouthkia; it would be foolhardy to draw any further conclusions about nutrition or genetic affinities.

It is disappointing that the largest sample of human remains for the Chalcolithic period on Cyprus should have been so poorly preserved. The sample reflects an absence of evidence for dental and osteological indicators of nutritional stress, but suggests that diet and environmental factors affecting health and longevity may have varied across southwest Cyprus. The dead population at Vathyrkakas exhibits more caries than earlier periods at Mosphilia and probably more caries than Mosphilia Period 4, perhaps as many as at Lemba, significantly lower incidence of thalassaemia, lower average adult longevity than at Mosphilia.

ADDITIONAL EVIDENCE FOR CHALCOLITHIC SETTLEMENT

There is a great deal more evidence from archaeological survey for settlement

in the Chalcolithic period than for any preceding period. In addition to site gazetteers (Catling 1962, Stanley Price 1980, Held 1992), the Vasilikos Valley Project (Todd 2004), Canadian Palaipaphos Survey Project (CPSP) and Western Cyprus Survey (Rupp et al. 1992), the Sydney Cyprus Survey Project (SCSP) (Given and Knapp 2003), and survey in the vicinity of Polis in northwestern Cyprus (Maliszewski 2007) all provide good data. Since most well-excavated Chalcolithic sites are on or near the coast, survey evidence is still the primary source of information about Chalcolithic activity in the interior of the island. Ceramic regionalism and, in some cases, faulty ceramic chronologies, complicate the interpretation of survey data.

Interpretation of the Vasilikos survey data, for example, depends on the relative chronological relationship of a handful of ceramic wares. The Early Chalcolithic wares are relatively well understood from the excavations at Ayious, but later phases depend on excavated sequences elsewhere, which might not parallel developments in the Vasilikos valley (Todd 1991, 12). To a large extent this has since been rectified by Clarke's excavations at Kalavassos *Pampoules*. It appears that in the Vasilikos region, Red-on-White probably continued into the Middle Chalcolithic, while the Black Stroke Burnished is Late Chalcolithic (Todd 1991, 12). The duration of purplish monochrome wares, however, is still uncertain (Todd 1991, 13; Clarke et al. 2007).

Four sites identified by the Vasilikos Valley Project were assigned to the Early Chalcolithic: Ayious, Tenta, Pampoules, and Kalavassos *Kafkalia* VI. Another site is inferred from old excavations by H.B. Walters, some material from which is curated in the British Museum (Todd 2004, 115-116). Of course, some identified Middle and

Late Chalcolithic sites may also have had earlier components that are not presently identifiable from surface ceramics. Additionally, some ceramic types like the heavy monochrome burnished wares (Todd 1991, 13) have yet to be assigned to a chronological range.

Ayious, Tenta, and Pampoules have been discussed above, and only a few additional points need be made here. The first is to emphasize that Ayious is practically adjacent to Tenta, at less than 0.5 km distance, while Pampoules is approximately a kilometer SW of Tenta and 0.5 km SW of Ayious. These three sites thus form something of a cluster, though clearly they should not be interpreted as contemporary “settlements.” They rather attest to a high degree of mobility and the use of different locations for specialized activities, as at Ceramic Neolithic Kokkinoyia (Clarke 2007, 18-19), and not dissimilar to the Early Chalcolithic activities at Mosphilia (Peltenburg et al. 1998).

Kalavassos *Kafkalia* IV is in the lower western slopes of the Vasilikos valley, just under 1 km due west of Tenta, about 0.5 km north of the Nicosia/Limasol highway that passes hard by Tenta. Site size is estimated at 0.225 ha, though different artifact classes covered different areas, and vegetation cover precluded a firm estimate (Todd 2004, 50). The presence of querns, axes, and ceramics suggested a settlement; since no architecture was noted, this may have been a complex of pits and ephemeral structures not unlike Ayious, which is visible from the Kafkalia hill (Todd 2004, 52). Todd noted, however, the absence of any water source in the immediate vicinity (2004, 52).

The Middle Chalcolithic is poorly attested, with only two site components:

Pampoules and Kalavastos *Arkangelos*, the latter less than 1 km north of the present day village of Kalavastos and not far west of the river but 40 m above it, with a precipitous drop (Todd 2004, 39). The site has Middle and Late Chalcolithic components and a significant Middle Bronze Age presence; to some extent this has obscured the nature and extent of Chalcolithic material (Todd 2004, 40).

There are seven reasonably securely documented Late Chalcolithic sites in the Vasilikos valley (excluding single finds and sites where the Chalcolithic presence is somewhat dubious). In addition to Pampoules and Arkangelos, these include Kalavastos *Potima*, Kalavastos *Melisotriba* East, Kalavastos *Yirtomylos*, Kalavastos *Kambanaris*, and *Asgata Neron tou Phani* (Todd 2004).

Kalavastos Potima is in the upper Vasilikos valley, 1.5 km north of Kalavastos village, on the east side of the river. It had a small Late Chalcolithic sherd scatter, some 45 sherds (Todd 2004, 96). *Kalavastos Melisotriba* East is some 400 m west of *Potima* and 300m north of *Yirtomylos* (below), close to the river and some 20m above it. Site size was estimated at 0.1 ha, suggesting “an isolated farmstead or a very small hamlet” (Todd 2004, 85). *Yirtomylos* is in the western Vasilikos valley, 1.5 km north of Kalavastos village. It has been damaged by quarrying and, like *Potima*, the Late Chalcolithic is attested only by a small sherd scatter. *Asgata Neron tou Phani* is another small sherd scatter in the northwest Vasilikos valley, more than 3 km northwest of Kalavastos village, and about 1 km from the river, in the zone above 200 m (Todd 2004, 32). *Kalavastos Kambanaris* is in the eastern uplands, 1.75 km NNW of *Kalavastos Tenta*, 0.75 km east of the river. At some 0.5 ha, it might represent a small

Chalcolithic settlement. It is assigned to the Late Chalcolithic on the basis of the ceramics, but the chipped stone may be earlier (Todd 2004, 54). No water sources were noted (Todd 2004, 54).

In apparent contrast to the Early Chalcolithic settlement pattern, these later sites are mostly in the upper Vasilikos valley; many are in upland areas at some distance from the river, and without obvious convenient sources of water, while others like Melisotriba East, Yirtomylos, and Arkhangelos are situated close to the river, but on bluffs above the floodplain. As several scholars have remarked, the small size, ephemeral nature, and generous inter-site spacing of Late Chalcolithic sites in the Vasilikos valley is in obvious contrast with the Late Chalcolithic in the west of the island (Todd 1991, 15; Bolger et al. 2004, 105).

The Canadian Palaipaphos Survey Project, and its successor, the Western Cyprus Project, investigated a large area in southwestern Cyprus including large sections of the Dhiarizos, Xeropotamos, Skotinis, and Ezousas drainages (Rupp et al. 1992; Rupp et al. 1993; Sørensen and Rupp 1993). Since much temporally insensitive ceramic material was recovered, their analysis often uses “Early Prehistoric” as a category for Aceramic and Ceramic Neolithic and Chalcolithic. However, some sites are able to be identified as belonging to different phases of the Chalcolithic. These seem to form a chain, up the Dhiarizos valley, from the Early Chalcolithic onward: there is little evidence for a dramatic increase in population in the Middle Chalcolithic.

The excavated Chalcolithic ceramic assemblage from Agios Savvas allow this

site, identified as an “average sized” settlement to be placed firmly in the Middle Chalcolithic (Clarke in Rupp et al. 1992, 392). Rupp et al. suggest that upland sites like Agios Savvas would have been isolated by virtue of their position, while sites like Mosphilia, Laona, and Pamboula, astride a putative east-west coastal trade route, were in much more frequent contact with one another (Rupp et al. 1993, 397).

This hypothesis receives some support from the results of the Lemba Archaeological Project Western Cyprus Survey (Sheen 1981, Baird 1985, Baird 1987, Bolger et al. 2004). The survey identified a large number (> 150) of Neolithic and Chalcolithic sites in three survey blocks. The first of these blocks is located around Peyai, north of the Lemba cluster of sites, the second west of the Drousha river valley, and the third in the upper Stavros tis Psokas drainage (see Bolger et al. 2004, Fig 8.1). The survey materials are still being studied by the investigators, who have not yet published a complete report on the sites surveyed. They have, however, made available limited results and advanced some hypotheses about the nature of Chalcolithic activity in these parts of western Cyprus.

Analysis is complicated by these workers' acute awareness of the problems of sub-regional ceramic typologies, including the uneven distribution of temporally sensitive wares. They have therefore paid careful attention to ceramic fabrics, as well as surface treatments, and made use of multivariate analysis to characterize assemblages at individual sites (Bolger et al. 2004, 111-114). Additionally, they found that lithic assemblages were both chronologically sensitive and different from site to site. Analyzing lithics not in terms of the presence or absence of tool types or raw

materials but as products of complex *chaines operatoires* revealed interesting patterning and allowed for the formation of hypotheses regarding raw material procurement, intersite interaction, and the social significance of lithics (McCartney in Bolger et al. 2004).

While details about the distribution and dating of sites are still forthcoming, several trends were observed. First, no substantial Early Chalcolithic presence was identified at any of the 150 sites in the three survey blocks; rather, much of the temporally sensitive material seems to date to the later Middle Chalcolithic and Late Chalcolithic (Bolger et al. 2004, 111). Second, the largest sites in Western Cyprus are almost all below 100 m ASL (Bolger et al. 2004, Fig 8.7), with smaller (<20000 m²) sites clustering in the range from 200-300 m ASL (cf. Adovasio et al. 1975). Third, there is a relative scarcity of Neolithic and Chalcolithic material between points of higher concentration identified as sites : no low-density carpet of artifacts as often assumed in Mediterranean survey methodology (Bolger et al. 2004, 108-9). chipped stone and ground stone more likely to occur off-site than ceramics (Bolger et al. 2004, 109).

A relatively small set of sites examined in detail was found to exhibit very different percentages of chronologically sensitive wares. For example, at Kissonerga-Mylothkia, RW was 17.7% of the ceramic assemblage, at Lemba 11.3%, at Souskiou-Laona 14.5% and at Trimithoussa just 0.1%, while Late Chalcolithic RB/B ware appears in lower quantities at inland sites as a percentage of the ceramic assemblage; but also at Lemba, which is on the coast ((Bolger et al. 2004, 112-113, Table 8.3).

Spatial variability in raw material for lithic tools was also observed. McCartney argues that at the sites of Chlorakas and Souskiou, higher quality Moni cherts were preferred, often used for the production of scrapers, a tendency also noted at Lemba, while Trimithousa exploited locally available cherts of inferior quality (Bolger et al. 2004, 119-120). McCartney attributes this variation to social behavior rather than resource availability or functional differences among lithic assemblages. Provisionally, it seems that larger sites had differential access to preferred high quality raw materials (McCartney in Bolger et al. 2004, 121), as well as utilizing different ceramics, while smaller ones like Trimithousa—perhaps like Ayias Savvas (Rupp et al. 1993)—were less involved in exchange of lithic raw materials and some types of ceramics. Whether this exchange network extended to the transport of foodstuffs, either ordinarily or in bad years, remains an open question.

An important point about the sites in the Drousha area is that they lie in a precipitation zone which typically receives about 600-700 mm of rainfall per year (Held 1992, 158-9), considerably more than the lowland sites. While detailed local studies of their geology and hydrology would be required to determine how much of that precipitation is retained as soil moisture under a mid-Holocene climate regime, it seems likely on a first approximation that they were less subject to drought than larger lowland sites and that the periodicity of harvest failure was much lower.

The Sydney Cyprus Survey Project (SCSP) and its successor the Troodos Archaeological and Environmental Survey Project (TAESP) also provide information about the Chalcolithic in inland areas, on the opposite side of the Troodos massif from

the CPSP and Lemba Western Cyprus Survey. SCSP operated in an study area of some 65 km² around the modern day villages of Mitsero and Politiko, and TAESP in an area of 161 km² in the Karkotis valley, and part of the Mesaoria plain (Given and Knapp 2003; Boutin et al. 2003). One of the most important results of these survey projects was the identification of the Middle and Late Chalcolithic site at Politiko *Phournia*. Phournia is apparently isolated, at some 15-20 km from the Late Chalcolithic cluster of sites around the village of Kato Moni (Given and Knapp 2003, 265; Held 1990, 14). Ceramics are consistent with a settlement, and resistivity revealed circular anomalies likely to be structures (Given and Knapp 2003, 266). It appears, therefore, that not only resource procurement but settlement extended into the foothills of the Troodos, at the juncture of the pillow lavas and the limestone sedimentary zone.

Confirmation of this pattern comes from the Polis-Pyrgos region in Northwestern Cyprus, the subject of investigation by Dariusz Maliszewski and colleagues for more than six seasons (Maliszewski et al. 2003, Maliszewski 2007). This survey covered the area from Kato Pyrgos to Polis *Chrysokhous*, ancient Marion, overlapping with territory covered by Raber (1987), Adovasio et al. (1975), Stanley Price (1979) and Steve Held (1992). Maliszewski records nearly 30 sites, including tombs and ephemeral artifact scatters, in the western Akamas peninsula and the steep upland valleys that drain into Chrysokhou Bay (2007, 90-95). Some are Early Chalcolithic in date, but most appear to belong to the Middle and Late Chalcolithic, which periods Held has argued witnessed a significant increase in population (1990, 203-4) on the north coast. This conflicts with the results of Adovasio's survey (1975)

of the Khrysokhou drainage, which suggested that Neolithic sites outnumbered Chalcolithic ones more than 5:1. These results, however, were based on the use of a faulty ceramic chronology that assigned much Chalcolithic material to the Neolithic (Bolger et al. 2004, 106).

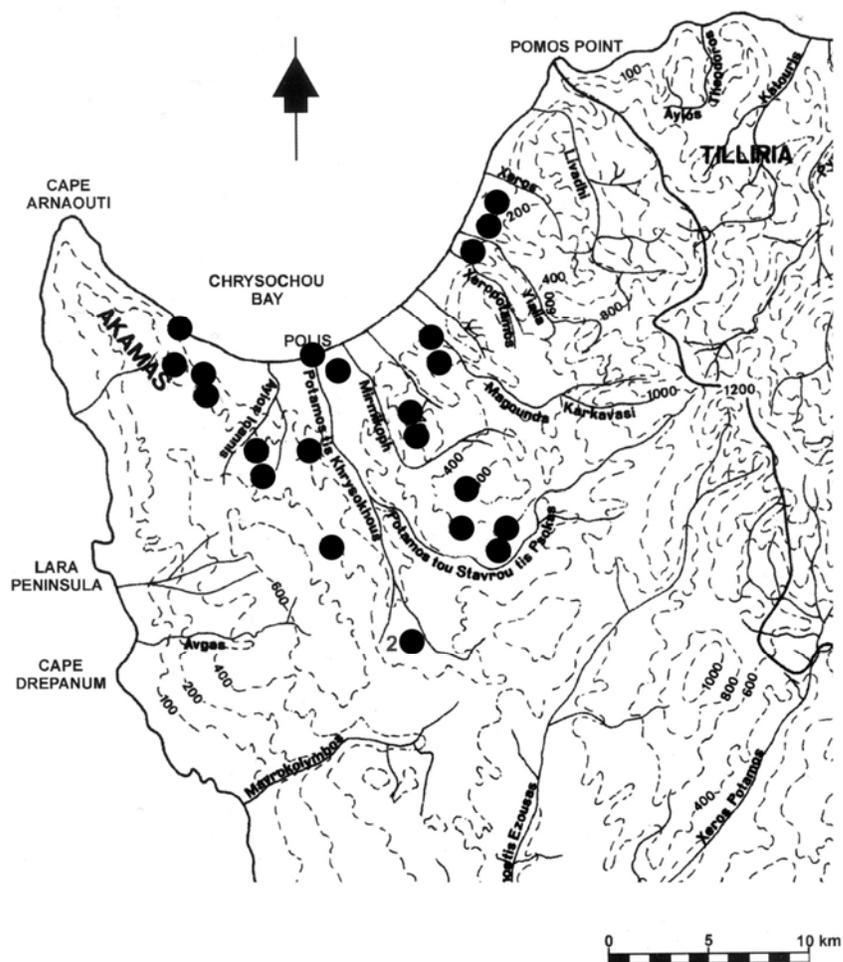


Figure 13. Chalcolithic sites in Khrysokhou Bay drainage (adapted from Maliszewski 2007, Figure 4).

While most of these sites are within 0-5 km of modern coastline (see map, Figure 13), there are also many in the upper reaches of these small river valleys, for example in the Potamos tou Stavrou tis Psokas (Maliszewski 2007, Fig. 4). The relative absence of sites west of Pomos point is probably to be attributed more to the fact that this area has not recently been surveyed, since parts fall in the demilitarized “Green Zone” and other parts are under Turkish Cypriot control, than to a real absence of Chalcolithic settlement. The sites are mostly small, in comparison with the sites of the Lemba cluster, and some of the sherd scatters and apparently isolated dwellings as at Fasli *Chorio* (Held 1992, 145) suggest a more dispersed pattern of settlement, as was apparently also the case in the Vasilikos valley. However, excavations at major Bronze Age sites such as Morfou *Toumba tou Skourou* and Classical period sites such as Marion and Arsinoe have also produced Chalcolithic material; the size and nature of the Chalcolithic components at those sites are basically undetermined, as is to what extent they were damaged or destroyed by later construction activity. It is impossible to rule out the presence of big Chalcolithic villages at these locations, but in the meantime, it would be unwise to assume that settlement everywhere on the island was as highly nucleated as was apparently the case at Mosphilia and Mylouthkia.

In the Polis region, as at Souskiou, burial of at least some members of the community outside of settlement precincts, in tombs cut into bedrock, seems to have been normal, to judge from the presence of several dedicated cemeteries, at Steni *Stavros* and Magounda *Mersinoudia* (Maliszewski 2007, 95). Niklasson's study (1991) gives a good idea of both spatial and temporal variability in burial practice over the

course of the Chalcolithic, but will need to be updated with the final results of work at Souskiou *Vathrykakas* (Christou et al. 2006). It is likely that the mortuary landscape was a major arena for the negotiation of ritual power and emerging status differences, as has been argued for the Middle Bronze Age (Manning 1993), but how this relates to control over subsistence resources is difficult to say without more substantial evidence.

DISCUSSION: SUBSISTENCE PRACTICE

AND RESOURCE STRESS IN THE CYPRIOT CHALCOLITHIC

Evidence for the nature of resource stress in the Chalcolithic of Cyprus, as in previous periods, is probabilistic rather than definitive, and requires careful discussion to avoid constructing circular arguments. Stochastic variation in precipitation may have been less dramatic than in dryer periods, thanks to the influence of the Mid-Holocene Wet Event, there is evidence to support a dryer climate thereafter; additionally, heavy rains can destroy winter wheat as effectively as drought. The increase in human population attested by growth in both the size and the number of sites, in combination with the important role played by wild resources throughout the period, will almost certainly have resulted in greater total human pressure on wild animal populations, primarily fallow deer, feral caprines and wild pigs, but also including coastal stocks of fish and mollusks.

The Middle Holocene is generally considered a period of relative climatic stability in comparison with the Last Glacial Maximum and the Younger Dryas. This

does not mean, however, that climate was static, merely that it changed within a more restricted range. After examining multiple lines of paleoenvironmental data, Robinson et al. have argued (2006, 1537) for a Mid-Holocene Wet Event in the eastern Mediterranean ca. 5000 cal BP or about 3000 BCE, coinciding roughly with the beginning of Period 3B at Mosphilia and Period 1 at Lemba. In this period, the pollen cores from Lemba reflect relatively high arboreal pollen, 5% or 6%, a figure which remains consistent for almost 500 years (Renault-Miskovsky 1985, 307 and Figure 5.12), while pollen from wet-loving plants (*Potamogeton* and *Sparganium*) is also present. In Lemba Periods 2 and 3, the pollen record suggests a trend towards a dryer climate regime. Arboreal pollen drops, mostly as a result of the decrease in pine pollen from 5-6% of the total to around 1%. Oaks are represented in 3 out of 6 samples (as against only one for Area I) but remain at around 1% (except for the late sample 6, in which they reach nearly 20%). Pollen from wet-loving plants is absent from Area II and the two later phases of the site (Renault-Miskovsky 1985, 307).

Most studies of Early Prehistoric settlement in Cyprus reflect a substantial expansion over the course of the Chalcolithic (Catling 1962, Stanley Price 1979, Held 1992). The largest Chalcolithic sites are substantially larger than those of preceding periods: Erimi and Mosphilia, at about 15 ha and 12 ha respectively, dwarf Khirokitia at about 3 ha and Kouphovounos at about 2 ha. While there is no reason to believe settlement density was uniform in all three periods, it seems safe to assume a significantly higher overall population in the North and West of the island in the Chalcolithic, especially the Middle and Late Chalcolithic. In other regions, such as the

Vasilikos valley, the picture is by no means so clear. It is important to recognize that our picture of the Chalcolithic settlement pattern is heavily biased by where archaeological investigations, particularly survey, have been conducted.

Previous studies have noted the concentration of settlement in coastal zones and the importance of river valleys and springs (Stanley Price 1979, Peltenburg 1982, Held 1992). It should be noted that while many sites form chains along river valleys, as in the Vasilikos and Dhiarizos, and to a lesser extent in the Polis/Pyrgos region, sites may also be located at some distance from known water sources. Bolger (1988, 18) proposes that Chalcolithic sites tend to be located at reconstructed boundaries between climax vegetation types (Bolger 1988, 21). Lacking a detailed vegetation inventory for the 5th and 4th millennia, we are forced to fall back on proxy data sets: modern vegetation, climate models such as those used by Robinson et al. (2005), ancient pollen, and charcoal. I have pointed out in Chapter 1 that vegetation does not necessarily follow geology, but there does tend to be a correlation.

To judge from the evidence reviewed above, ideal locations for Chalcolithic settlements will have provided access to suitable cropland: not only rich alluvial soils, but also lighter, more readily aerated soils, some still favored by modern Cypriot farmers (Christodolou 1959). Other desiderata will have been open grassland for ovicaprid pasture, and fallow deer habitat, probably open woodland. The willingness to use water sources at some distance from the physical nucleus of settlement has already been mentioned.

The establishment of new sites, whether seasonal and special-purpose camps or

year-round agricultural villages, was itself part of a pattern of “settlement discontinuity” (Peltenburg 1993) with important implications for social relations, but also for subsistence. The process of creating a new settlement might itself stress the resources of the community, calling for an investment of energy in new infrastructure, including land clearance, the relocation of stored resources, including surplus seed for the establishment of new fields. Establishing new settlements also necessarily affected the resource map available to inhabitants of the nearest settlements. A likely result of settlement expansion was greater pressure on wild animal populations, primarily fallow deer, feral caprines and wild pigs, but also coastal stocks of fish and mollusks.

All these sources of stress appear to have been addressed through a variety of economic strategies, some, like management of fallow deer herds, inherited from previous periods—and quite unlike contemporary behavior elsewhere in Southwest Asia (Croft 1991; Wasse 2007)—others apparently innovative, such as the adoption of new kinds of storage technology (big storage jars) and, in some cases, management of stored surplus in centralized locations, probably under the direction of a small subset of the community. To call this a strategy does not imply that it required the consent of the whole community; rather, it was a collection of behaviors with consequences for the survival and reproduction of the community as a whole.

While by the time of the Chalcolithic cereal crops were integrated into everyone's subsistence strategies to a greater extent than at the time of the establishment of early Aceramic settlements like Shillourokambos, the transfer of crops to new locations probably still carried risk. Such transfers will have happened

frequently with the establishment of so many new sites, where the hard work of “niche creation” was all to do again: land clearance, perhaps with the use of fire to encourage the production of new green for game and livestock (cf. Biswell 1967), learning local water sources, finding game trails and sources of raw materials such as clay and chert. Initial sowing of new fields with maslins might have served to test new locations, and to ensure some yield in the early, more vulnerable years of a new settlement. However, there is no site where botanical assemblages are sufficiently large and well-stratified to test this idea.

What we can infer from extant botanical assemblages is that there seems to have been substantial variation in cereal agriculture. At Mylouthkia, barley and wheat are found together in pit contexts, some of the grain apparently processed to remove chaff, some unprocessed (Colledge 2003, 242). At Mosphilia, on the other hand, samples contain more wheat chaff than grain, and more barley grains than chaff, implying these cereals were grown and processed separately. At Lemba, wheat might not have been grown at all (Colledge 1985c, 297).

The animal economies of the Chalcolithic, on the other hand, follow a common pattern. In an important paper, Croft (1991) compared the proportional representation of different animal taxa at Ayios, Mylouthkia, Lemba, and Mosphilia. Just as in the later Aceramic Neolithic, there seems to have been a decline in the proportional contribution of deer to the meat supply at Chalcolithic sites over the course of the Chalcolithic, nearly a millennium, as certain parts of the island saw a big increase in the number of sites (Croft 1991). Peltenburg has argued that the apparent

intensification in Periods 3 and 4 at Mosphilia might have been driven both by population growth and resource stress (1998, 254), and on the face of it it is tempting to extend this explanation to the whole island.

Within this pattern or trend of population growth, decreased hunting and increased herding, however, there is considerable variation. For one thing, survey evidence indicates that the increase in population over the course of the Chalcolithic was anything but uniform, from the Vasilikos, where the Chalcolithic was not a terribly crowded period, to the Lemba cluster of sites in the densely-populated West. For another, change comes more quickly at some sites than at others. Croft has observed, for example, that “the animal economy of Mylouthkia was consistently one step ahead of that from Kissonerga [*Mosphilia*]” (Croft 2003d, 236). Given the close proximity of these two sites, Croft rejects environmental differences in their site catchments as a plausible explanation for differences in their faunal assemblages and animal exploitation strategies (2003d, 236). In short, some regions saw big increases in population while others did not, and sites, including some very close together, shifted from deer hunting to ovicaprid husbandry at different times. This does not rule out a general environmental explanation such as dessication and deforestation after the Mid-Holocene Wet Event, but it implies that the proximate causes were non-simultaneous, potentially different at different sites.

Here it might be useful to consider the exercise attempted in the second part of Chapter 3, which considered what size deer population might have supplied half of the lean animal protein requirements for Khirokitia, a densely populated 2ha site of

perhaps 500 people. Since deer were even more important at Chalcolithic sites, let us assume that they accounted for 75% of animal protein consumed. Let us also make the conservative assumptions that population density at Mylouthkia was substantially lower than at Khirokitia, for a site population of 1500 people, and that 33% of total protein consumed came from animal sources. 1500 people consuming 25 g of animal protein/ day would require 3500 kilos lean protein/year. If deer furnished 75% of animal protein, 2625 kilos protein from deer would have been required. At 20 kilos protein/deer (mostly female, some juveniles), 131 deer would have to be taken annually to support the lean protein needs of the inhabitants of Mylouthkia.

Retaining the inputs for the Aceramic Neolithic model, a total population of around 875 deer would allow a cull of around 131 per year. Using the same density of 1 animal/4.6 ha (Apollonio et al. 1998), this gives a territory for these herds of 4025 ha or 40 square km. It is possible that the inhabitants of the Ktima lowlands took steps to enhance the production of browse to attract deer. In northern California, Native American groups used fire to manage the environment to enhance the productivity of vegetation suitable as browse for ruminants, attracting deer and resulting in deer population densities as much as four times higher in burned areas than unburned ones (Biswell 1967). Shepherds on the islands of the Northern Sporades in the Aegean Sea likewise used burning to encourage the production of green sprouts for their flocks (Sampson 2008).

However, all things considered, Mylouthkia is situated so close to Mosphilia, Lemba, and the site of Chlorakas *Vrysoudhia* that it seems certain the catchments of

these sites, at least for hunting purposes, must have overlapped—especially since some of the territory in the vicinity of the Lemba cluster must have been given over to cereal crops, and some may have been used as pasture for flocks, if sheep and goats were not kept in pens immediately adjacent to settlements (Halstead 1987). This in no way implies that the sites were conceived of by their inhabitants as having discretely bounded and defended territories; rather that many of the deer eaten at these sites likely came from the same region, primarily inland of these sites and probably between the Mavrokolymbos river drainage to the north and the Ezousas to the south.

In a seminal 1954 paper, H. Scott Gordon showed why “common property” resources like fish stocks tend to be overexploited to the point of collapse. A key point in his models is that stocks of fish are unevenly distributed in space and time, just as deer are apt to be. He saw his model as applicable to prehistoric foragers, and noted that many such groups did have in place certain limits and ownership structures which acted to prevent such overexploitation (see also Speck 1926, Kelly 1995, which reviews a great deal of relevant literature). Since deer hunters of Early Prehistoric Cyprus put not inconsiderable demands on the deer populations for millennia without causing any long-term population crash visible in the faunal record, it seems reasonable to consider that restraining structures or property rights may have existed. Indeed, Peltenburg has proposed that both property rights and status distinctions were established at Mosphilia by Period 3A (1998, 28).

It is in light of this situation we should consider the presence of fewer deer in house contexts than in general contexts, in contrast to other animals. To recap an

argument made above in Chapter 3, foraging groups tend to have sharing ethos for large game, especially where there is a high risk of failure, such that even good hunters who tried to feed themselves or their own family would experience long stretches without eating meat, perhaps becoming weak (Kelly 1995). In such cases, it appears to be to everyone's advantage to participate in systemic reciprocity (Hawkes 1990; Hawkes 1991; Hawkes et al. 1991). Sharing also plays social role in reinforcing intra-community bonds of kinship and obligation (Kelly 1995). Among the apparently “anachronistic” Epipaleolithic features of Early Prehistoric society in Cyprus might have been the long retention of an attitude towards hunting more characteristic of foragers than of sedentary farmers.

Societies with strong reciprocal social obligations tend not only to reward those who fulfill such obligations, but to punish defectors. This is possible in a context where people's consumption is subject to observation. It follows that displaying, distributing, and consuming deer meat publicly may have been a way for Chalcolithic hunters to “show off” and accrue prestige, a phenomenon which existed among semi-sedentary Eastern Woodlands maize horticulturalists in North America no less than among mobile foragers such as the well-documented !Kung and Hadza (Kelly 1995). This would account for the higher representation of deer bones than other food residue from contexts outside houses. One exception to this pattern comes from the Pithos House at Mosphilia. If the Pithos House was associated with an aggrandizing subgroup of the community, perhaps one of the innovations of this group was to co-opt the deer hunting tradition and bring deer meat indoors, in the context of control of

other foodstuffs.

What is more difficult to explain in this scenario is why herding failed to become a preferred strategy earlier, especially if it allowed individuals or kin groups to intensify production and give away less meat. In more densely populated parts of the island, some stresses probably arose from heavy reliance on hunted game during a long period which probably saw a multiplication of the number of mouths needing fed. Epiphyseal fusion data from sites in the Lemba cluster reflect more juvenile and subadult deer being culled over time (Croft 2003d), even as their contribution to meat supply decreases. Nonetheless, only at the end of the Chalcolithic is the supreme importance of fallow deer challenged by caprines.

Discussion of the physical storage, management, preparation and consumption of foodstuffs is severely limited by taphonomic processes and poor preservation of organics. However, over time there seems to have been a transition from the use of outdoor, publicly visible if not communal storage in pits to increased storage in ceramic vessels (and baskets, chests, and other facilities now lost) inside structures. Evidence also suggests a parallel trend from outdoor preparation and communal consumption to indoor consumption.

At sites like Ayios, which may have been part of a settlement pattern involving considerable mobility and bimodal residence, pits may have been used to cache food stores. However, it seems likely that mobility was more important than storage as a response to environmental stresses. The later bell-shaped pits on the Upper Terrace at Mosphilia in Period 2 have been interpreted as communal storage

area holding the produce of perhaps 25-50 ha of land given over to cereal cultivation (Peltenburg 1998, 241). Food processing at Mosphilia at this time was probably also communal and public, while the ceramic assemblage includes a variety of small and medium bowls, trays, but few closed vessels of any size (Peltenburg 1998, 240; Bolger 1998).

In Period 3A, pits outside structures were fewer and less carefully dug, while building B 1547 was built over older storage pits on the Upper Terrace in what may have been an act of “appropriation” (Peltenburg 1998, 26, 242). There are not yet any large ceramic forms suitable only for storage, but within stone-built structures there is evidence for indoor storage of food in smaller vessels and for indoor cooking and consumption at central hearths and earth ovens. Beginning about this time, terracing may have not only slowed erosion, but marked boundaries (Peltenburg 1998, 242, 244).

At Mylouthkia, too, Middle Chalcolithic houses brought storage, preparation and consumption indoors (Jackson 2003, 187). The social significance of this shift was probably considerable: not only were social relations played out primarily in a built environment, but sharing and consumptive practice of individual households were shielded from the view of the rest of the community (Thomas 2005, Watkins 2005).

By Period 3B, the structures of the Ceremonial Area at Mosphilia contained big storage jars and pithoi, representing substantial stored surplus, and a large number of earth ovens has been argued to relate to communal feasting (Peltenburg 1993, 14). In the high sector of the site generally a greater number of decorated “presentation”

vessels were recovered (Bolger 1998, Peltenburg 1998, 252). Period 4 saw the use of large holemouth jars and collared storage jars, which contributed to the estimated 4000 liters of storage capacity in the Pithos House (Peltenburg 1998, 254). The transition from an assemblage dominated by open presentation shapes to one containing many and large closed shapes suitable for storage is also visible at the other sites of the Lemba cluster.

To many workers, these facts have suggested the development of groups with disproportionate control of surplus, and are used alongside other data as evidence for incipient social ranking. In the context of the present study, changes in social complexity are of interest primarily insofar as they arose from and affected subsistence practice, local ecological parameters, and people's ability to withstand periodic stress events. Storing surplus in cache pits and ceramic vessels evidently proved a highly effective strategy, allowing villages to ride out inevitable bad years and to grow significantly in size. However, increased community sizes probably created scalar social stress (Johnson 1981, Peltenburg 1993), while the ability of farmers to provision their own families led to an erosion of the egalitarian ethos surrounding subsistence, and perhaps to “fighting with food”: competitive feasting and the strategic use of surplus to create relationships of obligation and status distinctions (Sahlins 1972; Halstead 2004; Hayden 1995; Hayden 1996). The feasting attested by the Ceremonial Area might have been an attempt to address these tensions through ritual, but the Pithos House indicates that some groups at Mosphilia continued to increase their control over surplus. It is one of the characteristics of feasts that they

can both act to promote community cohesion, or to creates social differentiation; the archaeological record is often difficult to interpret (Dietler and Hayden 2001).

The question of intercommunity relations in the Chalcolithic is complex and, like the apparent increase in social complexity, has been addressed at length by other workers. The increase in the number of sites in many parts of the island at the same time as increases in the size of the largest villages constitutes a plausible source of human stress on the capacities of local environments. Peltenburg (1991) saw the exchange of material culture such as microlite figurines as facilitating intercommunity contacts which functioned as buffers against resource stress, at least for those communities well-incorporated into such networks. The strictly defined house forms in the Middle Chalcolithic probably reflect shared ideology, but size differences between structures at Mosphilia and Lemba may also indicate that architecture was used “to reinforce status and social difference between the communities” of the Lemba cluster. (Gordon 2005, 122). While Peltenburg probed evidence for scalar stress and fissioning (1993), he did not deal with the issue of subsequent relations among these quarrelsome communities, particularly how they got on in the aftermath of a fissioning event: how they partitioned the resources on the landscape on which they relied; how all the resources of an abundant landscape were partitioned.

The shift away from deer to animal husbandry in the Middle and Late Chalcolithic makes good sense in terms of intensification of production in what may have been locally degraded landscapes (Wasse 2007). However, this is not the only possible explanation. Keswani argued that such intensification might also represent an

increasing need for young animals to be consumed in the context of ritual feasts promoting community cohesion and dispelling tensions (Keswani 1994). It is difficult to adduce the relationships between causal processes: population growth contributing both to demand for meat and to scalar stresses which may have demanded alleviation through feasting, at least if fissioning was to be prevented.

Peltenburg has suggested that fissioning was a not uncommon response to conflict within villages, and Cyprus would not be the only case (Bandy 2004). In the event of community fission, the ownership of livestock, particularly flocks of hardy goats, may have had some advantages for individual agents over rights in deer hunting territories. If livestock were indisputably private property--as opposed to hunted deer being a resource in some sense shared not only by the members of a single village but by the villages within a region--in this respect they would have offered a surer (spatially and temporally) future source of meat, subject to the control of a single individual or kin group. While goats can be kept in pens and fed fodder, it may have been more efficient to graze them on stubble fields and the open, semiarid grasslands attested by environmental data than to cultivate and transport crops specifically for their consumption. Mobile flocks will have required supervision, however, which might have made larger family units more advantageous.

Croft has argued that the faunal record at Chalcolithic sites reveals an unexpectedly large number of senior male goats (1991). Naturally, age and sex mortality curves often produce distributions which do not conform to the "ideal" distributions for the production of meat and other animal products (Russell 2005), but

it is precisely for this reason that the “ideal” curves are useful: to point to the existence of other social and ecological pressures that affected people's strategies. Perhaps, Croft speculates, older male goats' impressive horns made them valued possessions (Croft 1991, 74, Keswani 1994, 265). The high number of males might also indicate that flock sizes were small, if flocks were seen as requiring, for whatever reason, at least one, and more likely several, billy goats. Of course such a flock composition is not strictly necessary for reproduction, or particularly efficient from an energetic point of view: it is possible for stock breeders to keep only female animals, and rely on borrowing a male for stud services.

While few communities will have had needs anything like those of Mosphilia, which I have argued might have required 15 square km of land given over to cereal cultivation (perhaps in a system of rotation with well-attested pulses), and access to deer herds roaming over a territory of some 40 square kilometers beyond that. It is reasonable therefore to entertain the idea of conflict among communities over agricultural land and hunting territories. However—despite credible defensive earthworks near Mylouthkia, despite the not so much defensive as fetal posture of troglodytic Early Chalcolithic sites like Ayious—there are almost no signs of violent conflict before the Philia facies, which overlaps to some extent with both the Late Chalcolithic and Early Bronze Age, but which does not form part of this study.

The evidence reviewed in this chapter implies that over the course of the Chalcolithic, the human population of Cyprus increased to a level where, in places of high population density, it needed more resources than distance between sites could

provide. The exploitation of hinterlands, especially for deer hunting, but also for cereal cultivation, allowed the accumulation of substantial stored surplus as a buffer against harvest failures. However, as in many other ethnographically observed and archaeologically attested cases (Hayden 1995, 1996) such surplus eventually came to be privately controlled and used in competitive display and the creation of asymmetric relationships of obligation and power within village societies.

CHAPTER 6

DISCUSSION AND CONCLUSIONS

Previous chapters have characterized the variation in subsistence practice in Aceramic Neolithic, Ceramic Neolithic, and Chalcolithic village societies on Cyprus, and reviewed evidence for risk management strategies as discussed in Chapter 2. This chapter takes a more careful look at the structure of that variation over this almost 5000- year period of time, characterizes the distribution of subsistence practices and subsistence risk-reduction strategies among Early Prehistoric communities, and argues that subsistence practice and buffering strategies generally acted as a brake on social change, though at certain “watershed” moments, these very same strategies might become, in systemic terms, net deviation amplifiers, contributing to dramatic changes in material inequality and social organization.

VARIATION IN ENVIRONMENTS AND RESOURCES

While previous analyses (Catling 1962, Held 1983, Thiebault 2003) have found it useful to consider settlement in terms of the island's major geological and vegetation zones, in Chapter 1, the level of variation among microenvironments in soil types, water available from rainfall, aquifers, springs, and watercourses, and

vegetation, and the ability of these to lead to different stresses and economic results for early villagers, were emphasized. Listed below are pollen and anthracology data from selected Early Prehistoric sites:

Shillourokambos

anthracology

Quercus: 5-10 %

Pistacia: 20-40%

Pinus: 1-5%

Olea: 22-68%

Arbustus: 32% (in Early Phase A only)

(Based on Thiebault 2003, Fig. 2. All percentages are approximate based on pollen diagram, and conflate samples from multiple levels)

Khirokitia

anthracology

Quercus: 5-20 % (except G1-G2, 40%)

Pistacia: 5-50%

Pinus: 2-75%

Olea: 5-10%

Ficus: 2-10%

Fraxinus: 5-10%

(Based on Thiebault 2003, Fig. 2. All percentages are approximate based on pollen diagram, and conflate samples from multiple levels)

Pollen (Column 2, Levels 4-1)

arboreal pollen 1-5%

Graminae (including cereals) 5-30%

Cichoriae 20-90%

(after Renault-Miskovsky 1989, 259-260 and Fig. 70. All percentages are approximate based on pollen diagram, and conflate samples from multiple levels)

Lemba

Pollen (Area I)

arboreal pollen 5%

Graminaceae 6% (including cereals, 0.5-1.5%)

Cichoriae 50-70%

Pollen (Area II)

arboreal pollen 1-25%

Graminaceae 0-7% (including cereals, 1%)

Cichoriae 50-80%

(Renault-Miskovsky 1985, 307 and Figure 5.12. All percentages are approximate based on pollen diagram, and conflate samples from multiple levels)

While it appears that no single type of microenvironment was selected for Early Prehistoric settlement, there are certain trends: contrary to assumptions that Early Prehistoric farmers must have colonized an island covered in climax forest of pine and oak, available palynological data and present-day vegetation that farmers actively sought out semi-open coastal grassland and mixed forest requiring comparatively little clearing for cultivation, rather than heavily forested upland areas. This seems to have been especially true where a variety of rich alluvial soils and lighter, readily-tilled soils were available adjacent to water courses. Such areas were consistently chosen even where they received lower average annual rainfall and had (historically) higher frequencies of drought.

Another common features of Early Prehistoric settlement is proximity to water sources, whether in the form of water courses, springs, or both—though again, survey evidence indicates that this is far from a universal feature, with many upland sites in the Vasilikos valley located more than 1 km from the closest known water sources, and even some sites on the northern coastal plain situated 0.5-1 km from water sources. The hydrology of Early Prehistoric Cyprus deserves its own study, though this would only be possible with a better understanding of the far more extensive landscape modifications of the past 5000 years. Held's gazetteer of Early Prehistoric settlement showed that they tended to be located in areas below 300 meters above sea level and receiving between 400 and 500 mm of rainfall a year, on average. Ayious, Tenta, indeed, most of the sites in the Vasilikos valley with the significant exception of

Mari *Mesovouni*, Khirokitia, Vrysi, Troulli, Sotira, Mosphilia, and Mylouthkia, all fall in this zone (Held 1992). Naturally, local landforms and topography will have affected how much rain actually fell at individual locations, and precipitation may have been greater than 500 mm under wetter climate regimes.

While rainfall is the single most important variable affecting yields in dry agriculture, Held rightly emphasized (1983) the role of vegetation and bedrock geology in affecting both runoff and transpiration. These processes also have the potential to create feedback loops, whereby vegetation changes affect runoff which accelerates erosion, in turn affecting vegetation. For example, Redman (1999, Fig. 5.5) provides a useful example of a case where thicket and grass approximate no erosion, while land under millet cultivation experiences a 26% loss of rainfall as runoff and a soil loss of 70 tons/ha/year.

Throughout the Early Prehistoric, rivers and streams were important factors in attracting settlement (Catling 1962, Stanley-Price 1979). Running water was probably the primary source for the daily water needs of people and animals, and may also have been used to water crops. The largest sites of every period—Khirokitia, Kantou, Erimi, Mosphilia—are located by rivers. Settlements adjacent to perennial streams may have had an advantage over those located by seasonal ones, or in upland areas with small streams or none. Riparian vegetation probably provided an additional subsistence resource, as well as attracting birds and deer, and reeds or rushes are a valuable raw materials for everything from roofs to mats, baskets, and floor coverings. That they were brought back to Early Prehistoric sites in quantity is suggested by the

presence of freshwater snails at Mylouthkia and Ayious, assumed to have been brought in with the reeds. The gradual shift in settlement over the course of the Early Prehistoric to a pattern in which the largest sites were located in river valleys on the southwest coastal plain might reflect a gradual shift of population to areas where it could best be consistently supported by an abundant fresh water supply (cf. Fig 4 on p. 51, showing the position of selected Early Prehistoric sites relative to perennial stream flow,).

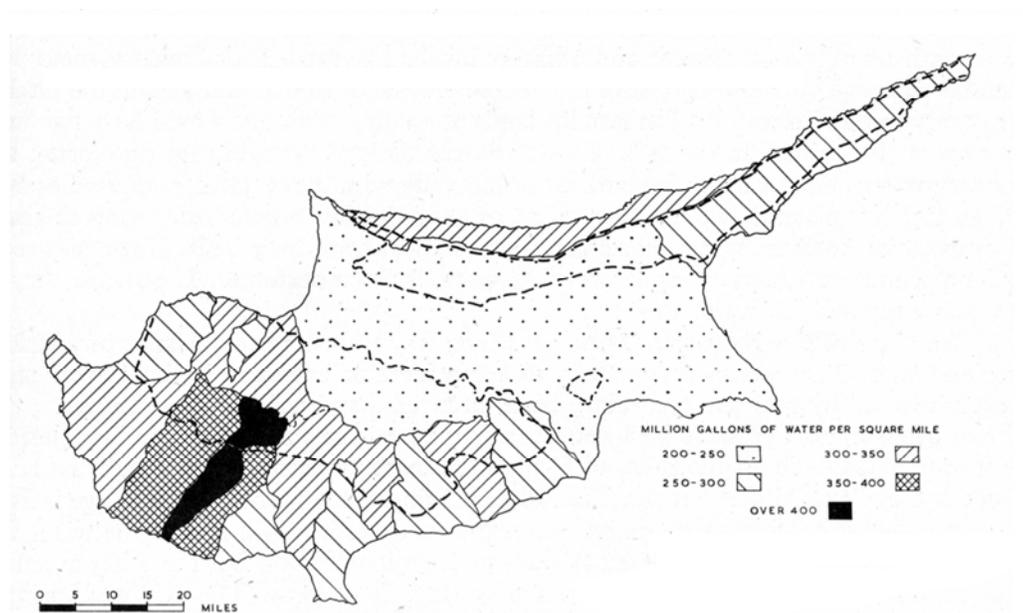


Figure 14. Runoff by catchment area (adapted from Christodolou 1959)

Rivers and streams are not the only available sources of fresh water. Where bedrock geology is permeable, a certain amount of rainfall is potentially stored in aquifers, like those in the Kouris valley (Bolger 1988, 15-16, 20), where it is available to people through springs and wells. These aquifers may have been a strong attractor

for Early Prehistoric settlement: Mylouthkia, Erimi, Lemba, Vrysi and Troulli would all have been in a position to take advantage of water obtained from wells and springs, especially at times when the seasonal watercourses near these sites ran dry (Xenophontos 1985).

While Early Prehistoric farmers seem to have preferred open grasslands near the coast, especially in the vicinity of rivers and streams, settlement also extended into upland areas, documented largely by archaeological survey. Sites like Ortos, Dhali Agridhi, Ayias Savvas and Politiko *Phournia* all lie in areas which may have hosted pine forest in the early Holocene (Held 1992; cf. King 1989; Simmons 1994, 3). In short, Early Prehistoric people were able and apparently willing to tolerate a range of conditions in terms of average annual rainfall, access to running water, stream flow, and bedrock geology. One possible cause is that it was advantageous to have ready access to a number of microenvironmental zones: open grasslands, mixed deciduous forest, upland pine forest, coastal areas, and riparian zones. This may have to do with the importance at almost every Early Prehistoric site of mixed strategies in which hunting, herding, and farming all contributed to subsistence, and the resilience of such mixed strategies to periodic stress. Furthermore, just as access to a number of different microenvironments may have been adaptive on a site level, so the distribution of sites in a variety of geological and vegetational regimes may have provided a collective advantage for Early Prehistoric societies in general.

Here as with other lines of evidence change over time is highly illuminating. Relevant evidence for environmental change has been reviewed in the preceding

chapters. A key point is that global climate change may have had a variety of localized impacts, and that landscapes in the vicinity of human sites were also shaped by human and animal activity. These are not easy to track, but geomorphological evidence for erosion, pollen and anthracology, and faunal data all provide information, especially if they are read alongside one another.

Global climate background is always important, but it on Cyprus there are few if any climate changes which are therefore plausible causes for immediate social change. Conditions in the Early Holocene may have favored expansion and settlement on Cyprus by agricultural groups (Wasse 2007). The Mid-Holocene Wet Event (Robinson et al. 2006, 1537, and see Figure 3, on p. 47) coincides with expansion in the west, Period 1 at Lemba and Period 3B at Mosphilia, in which the settlement apparently grew in size. Drier conditions throughout southwest Asia generally after the Mid-Holocene Wet event are probably related to botanical evidence for aridification in the vicinity of Lemba, and there may be a causal relationship with observed increases in storage and changes in animal economies (which were not contemporaneous at Lemba, Mylouthkia, and Mosphilia). The spectre of aridification has often been evoked in discussions of site abandonment, but it is difficult to attribute any of the apparent hiatuses in occupation at the end of the Aceramic Neolithic and Ceramic Neolithic, or the visible investment of energy in new settlements at the beginning of succeeding periods, to independently identified changes in global climate. Rather, erosion, vegetation, and animal evidence all suggest non-contemporaneous environmental changes at the level of sites and regions.

Evidence for erosional processes in the Early Prehistoric is often disguised by subsequent, far more severe erosion, which in some cases has removed tops of settlements; in other cases, as in the lower Vasilikos valley, deposition has buried Early Prehistoric settlement under meters of fill. At Mylouthkia, the existence of terrace and field walls were inferred from Period 3A from the use of field stone in structures, and what seems to have been relatively moderate erosion in the immediate vicinity of the site (Peltenburg 1998, 242, 244).

Erosional processes related to agriculture are capable of creating a negative feedback loop: land has to be cleared for planting crops, but is then susceptible to increased erosion due to the lack of ground cover; the lack of vegetation cover also inhibits in situ soil formation; as erosion removes more soil, areas become less profitable for agriculture but are not readily colonized by species that begin the process of regeneration; even in the absence of soil depletion and population growth, farmers eventually need to clear and cultivate new land, exposing it to erosional processes. In terms of spatial and temporal distribution, therefore, we would expect more severe erosion at bigger sites with greater need for agricultural land and fuel, and topography tending to exacerbate erosion, all other things being equal. To test this hypothesis would require comparative geomorphological study of the hinterlands of Early Prehistoric settlements.

Pollen and anthracological data suggest changes over time tend to track individual site histories to a greater extent than large-scale climate events. While workers on Cyprus have often referred to landscape degradation in connection with

changes in pollen cores, animal economies, and site abandonment, careful examination is necessary to see whether such hypothetical degradation is supported by the available evidence.

With reference to the greater Levant, Redman has proposed the following sequence for anthropogenic landscape degradation: Holm oak climax forest (*Q. ilicis*) gives way to scrub oak (*Q. coccifera*) which in turn yields to heath (*Cistus* sp. and *Thymus vulgaris*) and finally to turf (*Asphodel carasifer* and *Brachypodium ramosum*): any further degradation is likely to result in complete soil erosion and bare rock (Redman 1999, Fig. 5.4). Most often, however, the sequence does not run its course: rather, a temporary equilibrium is reached. One common point of equilibrium is a resilient “scrub ecosystem,” produced by constant pressures favoring plants resistant to fire, cutting and animal grazing (Redman 1999, 102).

This proposed sequence is not reflected in the pollen and anthracological histories of Early Prehistoric sites, which, as argued above, rather reflect initial selection by human groups of site locations with mixed woods and open meadows producing high levels of *Asphodel* and other meadow plants, lower levels of arboreal pollen, and low levels of pollen from wet-loving plants. Moreover, local vegetation changes over the course of human occupation are different from site to site, not following similar sequences.

At Shillourokambos, there is a big decrease in strawberry tree after Early phase A, and a big increase in wild olives in B/Middle and Middle phases (Thiebault 2003, Fig. 2). These vegetation changes are not duplicated at the Mylouthkia wells (with all

their depositional and preservational problems). At Khirokitia, the earliest levels (G1-G2) exhibit high levels of oak charcoal, which fall off subsequently-but even so, to levels higher than those at Shillourokambos throughout its whole occupation (Thiebault 2003). Levels of wild olive, on the other hand, do not begin to approach those attested at Shillourokambos. Evidence for an apparent decrease in *Pistacia* and an increase in pine pollen relatively late in the history of the settlement comes from pollen cores in the West sector within which there is little change in the representation of these two kinds of trees over time (Thiebault 2003, Fig. 2). At Lemba, vegetation history reflects dry, open fields and meadows throughout the occupation of the site; river plants are also represented (Colledge 1985b, 209). Palynology suggests this particular part of the Ktima lowlands may have experienced aridification in Periods II and III (Renault-Miskovsky 1985), but the particular vegetation history, with such features as the increase in meadow-rue, is not duplicated at nearby contemporary sites, insofar as can be judged from their botanical assemblages (see Chapter 5).

As with crops, people have many reasons for making changes in their hunting and herding strategies independent of change in environmental parameters (Russell 1999). At Shillourokambos, the decline of cattle-raising has no obvious relationship to the changes in the local environment which resulted in the decline of strawberry tree and the growth of wild olives, While at Khirokitia, the increase in sheep in later levels of the West sector does coincide with other evidence suggesting a dryer environment, one in which pines (*P. brutia*) were comparatively abundant (Thiebault 2003, Fig. 2). Additionally, an increase in sheep herding in the latest phases of the West sector does

coincide with a fall-off in cereal pollen (Renault-Miskovsky 1989, Fig. 68-71), providing additional support for Wasse's claim of landscape degradation.

At Lemba, change in the animal economy often has little obvious connection with paleobotanical information or with trends at Mosphilia and Mylouthkia. The increase in the importance of pigs to more than 50% of the meat index by Period 3 (Croft 1985b, 204 and Table 128), under apparently dryer conditions than earlier periods, is far more dramatic than changes at either Mosphilia or Mylouthkia, where pigs became more prevalent as deer decreased. Equally interesting, this trend is unlike the response at other sites of different periods, such as Khirokitia, where aridification has also been inferred. If increases in sheep and goats are often taken to reflect aridification and deforestation, what is to be inferred from dramatic increases in the representation of pig, such as at Cap Andreas? Presumably a resurgence of arboreal vegetation, particularly deciduous nut-bearing oaks and pistachios; however, it hardly seems likely that the hinterlands of Early Prehistoric agricultural villages became more heavily forested over time, nor is this borne out by seed or pollen data. In fact, the representation of pigs seems to have little relationship to local vegetation regimes, either spatially or in terms of change over time.

In summary, roughly contemporary Early Prehistoric sites had different vegetation histories and different responses to aridification, where this can plausibly be inferred. That many changes in plant foods do not bear immediately obvious relationship to changes in animal economies suggests something about the nature of both: not only that there is a high noise-to-signal ratio in both data sets, but that

subsistence strategies were conservative and resilient.

VARIATION IN SUBSISTENCE

We turn now from the evidence for variation in local environments to that for variation in subsistence practice. In Chapters 3-5, individual sites have been discussed in terms of the plants and animals that furnished food, the environment in which they were grown, raised, and hunted, seasonality, evidence for the organization of agricultural and other labor (usually at the household level, with some exceptions), and other variables. From the Early Aceramic through the Late Chalcolithic, people on Cyprus generally relied on similar sets of resources—wheat, barley, lentils, sheep, goat, and pig, with the addition of fallow deer. However, people used the elements of this “Early Prehistoric package” in very different proportions. Additionally, plants such as vetches, ryegrass, and acorns might have been fodder for animals at most times and “starvation foods” for humans during times of high stress, but they appear consistently in the archaeological and paleobotanical records. It would be unwise to insist too stringently on the distinction between “wild” and “domestic” plants. Stands of wild barley were exploited and placed under selective pressures; goats and pigs went feral and were hunted. For some coastal sites, marine resources such as fish, molluscs, and sea turtles provided a significant addition to diet, probably on a seasonal basis; land snails in archaeological contexts are usually treated as intrusive, but these species are edible too.

The very different community sizes and geographic situations of Early

Prehistoric sites demanded different tactics, from the foundation of a new settlement, through (as I have argued) processes of “niche creation,” to settlement fissioning or abandonment in the face of insurmountable difficulties or more attractive opportunities elsewhere. The locations of fields for cereal crops and gardens for vegetables, the hunting territories and the many uses of marginal land, are not immediately apparent from the archaeological record, but something about them can be inferred from paleobotanical and anthracological evidence, along with settlement patterns, as in the case of the Late Chalcolithic in the Vasilikos valley (see Chapter 5). The following discussion of variation in subsistence is therefore organized in terms of plants, animals, local environments, and settlement patterning and land use; first as evidence for spatial diversity and second as evidence for change over time.

Ideally, it would be possible to use botanical records to assess both the range of species represented at a given site and their relative importance. However, this is obviated by processes of deposition and rates of recovery which are far from uniform: since the number of species recovered tends to increase with the amount of soil floated, since preservation is not equally good or bad in all places, the ratio of “noise” to “signal” is often simply too high to use botanical data to argue, for example, that the number of species recovered at one site as opposed to another represents a useful relative measure of diversification, or that the ratio of wheat:barley:legumes is consistently representative of the proportions in which these were grown and consumed. This does not mean quantitative data should be ignored, however.

Spatial variation in plant assemblages occurs primarily in less well-represented

wild plant species. Domesticated and “managed” morphologically wild cereals were clearly major contributors to diet across the island and throughout the Early Prehistoric. The best represented are einkorn and emmer wheat, with only a few examples of bread wheat and, at Mylouthkia, possible hybrid wheat strains (Colledge 2003); barley; and lentils. Particularly with regard to the latter two species, morphologically wild strains continued to be exploited alongside morphologically domestic ones.

Held's argument that wheat was more important than barley north of the Kyrenia range and barley more important in the south (1983, 158) makes good sense in terms of the land use patterns and rainfall documented by Christodolou's indispensable study (1959). It was also consistent with the archaeological information available to Held: at Cap Andreas, almost twelve times as many wheat grains and spikelets were recovered as barley (Van Zeist 1981, 97 and Table 1), and at Vrysi, emmer wheat was far more common than barley, whereas at Lemba hulled barley was the best represented crop, with only one sample of bread wheat preserved. However, the hypothesis is not born out by the expanded paleobotanical data set now available.

At early Aceramic Neolithic Shillourokambos and Mylouthkia, there is evidence for wild barley, domestic barley, single-grained einkorn and emmer wheats, though the proportions of these are very difficult to ascertain given the calcification of botanical samples at Shillourokambos and the nature of the deposits at Mylouthkia (Willcox 2003, 235). At Dhali *Agridhi*, einkorn dominates, with no emmer or barley reported. At Tenta, einkorn and emmer occur in roughly equal proportions, with

einkorn possibly giving way to emmer over time (Hansen 2005, 326-7). Barley may have been grown as a component of maslins but was not apparently dominant (Hansen 2005, 327). At Khirokitia barley is very poorly represented relative to einkorn and emmer, possibly due to preservational factors (Hansen 1989, 237). At Chalcolithic Mylouthkia, not far from Lemba, emmer wheat was grown, along with a possible *monococcum/ dicoccum* hybrid, and hulled barley (Colledge 2003). Thus considerable variation in the use of cereal crops appears to have been possible even within sites less than 10 km apart in what has traditionally been treated (e.g., by Held, 1992) as a single ecological zone, the southwestern coastal plain. This lack of uniformity, it should be emphasized, is apparently different from the southern Levant in the eighth millennium BCE, where barley and emmer were nearly always paired (Van Zeist and Bakker-Heeres 1982).

The importance of maslins and polycropping strategies on Cyprus bears reiteration. Vetches and other weeds which commonly accompany cereal crops occur both at sites and in periods in which domestic animals were important, and at sites at which deer predominated. This suggests that there is no relationship between a high representation of vetches and a high representation of domestic livestock such as goats for which vetches were sometimes, in traditional agricultural systems, grown as fodder (Halstead 1987; Halstead 1989; Forbes 2007). There are, then, two likely explanations for the presence of vetches: as weeds incidentally harvested accidentally along with cereals and other crops, and as a wild crop in their own right, deliberately harvested. The two mechanisms are not mutually exclusive, but presumably one will have been a

more important explanation for the presence of vetches at any given time. Willcox has drawn attention to the high frequency of ryegrass, *Lolium*, at Khirokitia, where it probably grew alongside wheat (predominantly einkorn) but may also have been eaten. It also occurs at Cap Andreas and Lemba, though the rye identified at Chalcolithic Mylouthkia is apparently domestic cereal rye, *Secale cereale* (Colledge 2003).

It is difficult to determine where inter-site differences in wild plant assemblages represent real variation in the use of resources, and where such differences are an artifact of sampling. This problem can in part be addressed by botanical survey to document the range of plants present in the vicinity of sites, but then of course there is the question of change in local environments over the past ten to five thousand years. Rather, than, then building arguments on the absence of taxa, it is best to look at what is universally or nearly universally represented. In particular, wild olives, *Pistacia*, and figs all deserve consideration. It is probably no coincidence that these plants, among the best represented on Early Prehistoric sites, all yield fruits that are first, high in energy, and second, easily processed for long-term storage.

Wild olives seem to have been used almost everywhere on Cyprus during the Early Prehistoric. While processing the olives for consumption would presumably require salt water, at least if traditional techniques of processing were used, crushing them for oil would not have necessitated this (Riley 2002; Kailis and Harris 2007). Both olives in brine and olive oil keep for multiple seasons and are therefore valuable additions to a household's stored resources. Wild olive pits, pollen, and charcoal were

documented at Shillourokambos, Dhali (probably), Cap Andreas, Ortos, Tenta, Khirokitia (though few), Vrysi, and Chalcolithic Mylouthkia. However, they were clearly more important in some places than others. The probable intensive use of wild olives at Shillourokambos, attested by charcoal, finds no parallels until, perhaps, the Pithos House, while only a few pits are documented at Khirokitia, according well with the low representation of olive pollen. Olives yield about 115 kcal for 100g; olive oil 884 kcal for 100g (USDA nutrient database). Therefore, a holemouth jar of olive oil represented a great many more calories than a similarly sized jar of olives in brine: even where gas chromatography is feasible, it will not necessarily allow the two to be distinguished. As a result, it is best not to automatically infer a huge number of stored calories from a large assemblage of jars.

Nuts seem to have been a fixture of diet in the Early Prehistoric, though not nearly so important as in the case of semi-sedentary foragers in present-day California, for example (Baumhoff 1963; Baumhoff 1978). The fruit of various species of *Pistacia* could be eaten or processed for oil (Pourezza et al. 2008). The nuts of *Pistacia vera*, the large pistachio familiar to us, has a nutritional value of 570 kcal for 100 g (shelled), 46% fat and 21% protein (USDA nutrient database). I have been unable to find figures for the nutritional value of the oil. Wild olives tend today to be found at lower elevations (Held 1983; Held 1992), but this does not account for their high representation at Shillourokambos and low representation at Khirokitia. Under the present climate regime, wild *Pistacia* are more or less restricted to the coastal plains; though orchards of *Pistacia vera* are maintained elsewhere with the aid of

modern techniques of plowing, fertilizing, and watering. The distribution of these trees may help to explain why people apparently favored settling at the junctions of different environmental zones, including lowlands which periodically received rainfall insufficient for successfully dry farming of wheat.

Fig seeds have been recovered from Tenta and Khirokitia, Vrysi, Lemba and Mylouthkia, all sites which produced wide ranges of botanicals overall – and, not coincidentally, sites at which large amounts of soil were floated. Figs are thus less well-attested in the Early Prehistoric than either wild olives or *Pistacia*, a fact somewhat surprising given their importance throughout the Mediterranean world in later periods. On the one hand, each fig contains hundreds of seeds; on the other, the seeds are typically eaten, in contrast to olive pits, nut shells, and the stones of fruit such as plums, and there are few opportunities for them to become carbonized; in addition, their small size may put them at a disadvantage for preservation and recovery. Figs are readily preserved by drying in the sun, “passive processing” with relatively low labor cost compared to the preparation of some other foods. It has been suggested (Peltenburg 1985, 321) that some of the flat trays which are characteristic features of Ceramic Neolithic assemblages may have served for drying them. Dried figs have a nutritional value of about 250 kcal/ 100 g (USDA nutrient database).

Today, fig trees occur all over Cyprus at a range of elevations, wherever they find adequate water. One factor restricting the spread of figs is that fig trees must be pollinated by the wasps of a species specific to that tree, in a textbook example of mutualism. Under some traditional agricultural regimes in Greece, farmers considered

dried figs suitable as animal fodder under normal environmental conditions (Halstead 1987; Halstead and Jones 1995; Forbes 2007). However, these seem to have been the hermaphrodite caprifigs, not the fruit of the female fig tree, which, fresh, was considered suitable for human consumption.

In addition to wild olives, *Pistacia*, and figs, Cyprus likely possessed a wide variety of wild fruit-bearing trees within a relatively small geographical area, as compared to the Levantine mainland (Willcox 2003, 237). Today, when fruit is an irrigated cash crop, it is common to see fruit trees, but this would not have been the case in the past. *Prunus*, for example, while found on Cyprus, is absent from Aceramic Neolithic assemblages on the mainland (Willcox 2003, 237). In addition, fruit such as wild grapes, hackberry, sloe, and apple are attested on Cyprus. Acorns may have been a significant resource either as food for pigs or people (cf. Lewthwaite 1988) but would likely require processing with fresh water in order to remove sufficient tannins to be edible to humans, and it might have been more efficient to allow pigs to eat them. Oak pollen and charcoal as a percentage of arboreal pollen and identified charcoal varies widely: its influence on animal husbandry and hunting strategies is discussed below. Mallow is a ubiquitous feature of Early Prehistoric botanical assemblages. Capers have thus far been recovered only at Tenta and Mylouthkia, but today are common and widely distributed on Cyprus, easy to find by the roadside, in ditches, and places where they can find enough water. Mallow, along with olives and chicory, sustained Horace, the abstemious Roman poet (*Odes* XXXI.15), while the polymath Pliny commented on the medicinal properties of capers (*Natural History*

XIX, XLVIII.163). These wild plants would have provided few calories but essential nutrients such as Vitamins A and C and iron. The relatively wide range of fruits available within the catchments of individual sites on Cyprus as compared with the southern Levant may have encouraged a broad-spectrum approach to wild plant foods.

Several trends are visible in the aggregate change in plant assemblages at Early Prehistoric sites. One is the adoption by existing villages of new crops and plant foods in addition to the old staples they had had from their foundation. At least some of these new foods seem to have been introduced from outside the island. However, this seldom if ever resulted in a disproportionate concentration on any single cereal or wild plant food, with the possible exception of wild olives at Shillourokambos. Second, changes in wild plant foods do not bear immediately obvious relationship to changes in animal economies. This constitutes weak negative evidence, but supports the argument developed in the preceding chapters that strategies tended to be conservative, integrated but independent, and resilient.

Willcox has drawn attention to the fact that in Cyprus as in the Levant, morphologically domesticated mutations were not always quick to replace “wild” ones (2003, 233). In part because moving cereals from one set of climatic conditions to another can result in crop failures (2003). He suggests that “colonizing” populations relied on wild barley, which, unlike wheat, is endemic on Cyprus. Wild barley is present in the earliest phases at Shillourokambos, and in Period IV at Tenta, though there are no good botanical data for Period V. There is little obvious sign of a change in preference for any of the various cereal species: no marked shift, for example, from

emmer to einkorn. Evidently, different cereals all had their place as late as the sophisticated mixed farming economies of major Chalcolithic sites.

One of the most dramatic changes in utilization of wild plants is the significant increase in the representation of wild olive from the Early to Middle Phase at Shillourokambos. It is of interest precisely because no comparable change is documented at any other village among the Early Prehistoric sites considered. Since this apparent increase is based on anthracology, three general hypotheses have to be considered. The first is that the increase does not represent more olive wood burned, simply more deposited or preserved. Second, the increase in charcoal samples represents more olive wood burned, but this is not connected to any increase in consumption of wild olives; and third, that more olive wood burned and that this reflects an increase in management of wild olive trees and consumption of wild olives. If the third case, it is worth asking while similar trends are not evident at roughly contemporary sites.

There is no *prima facie* reason to suspect a big change in the deposition or preservation of olive charcoal as opposed to other species in the Middle Phase. While many factors might have led to increased demand for firewood—a growing population, increased use of fuel for production of plaster, change in cooking practice—it is unclear why any of these would produce a disproportionate increase in the amount of specifically olive wood burned.

The possibility that the increase represents more olive wood burned, but that this is not connected to an increase in consumption of olives, has to be seriously

considered. The Middle Phase might have seen increased land clearance for cultivation, but the question remains why this should have produced a proportional increase in the representation of olives as against any of the other trees in the vicinity, such as the oaks, which remain within a few percentage points of 10% in all periods for which there are anthracological data. Especially given the food value of olives, it seems doubtful that stands wild olive trees would have been disproportionately selected for removal, even if they, unlike pine, tended to occur on the best land for farming cereals. Furthermore, similar patterns of burning do not appear at other sites in periods of apparently agricultural expansion.

The third hypothesis, that the data set reflects more olive wood burned and that this represents an increase in the consumption of wild olives, cannot be definitively tested, but appears to be plausible. The Middle phase, in which olive charcoal peaks, saw the virtual disappearance of cattle and the beginning of increased investment in ovicaprines, as well as possible aridification (see below). However, as I have argued above, faunal data point to relatively a relatively affluent animal economy. Ultimately, then, the heavy exploitation of olives is a spatially restricted phenomenon which would only have been possible in areas with unusually high concentrations of wild olive, but which did not appear elsewhere even in areas where today the species thrives. There is no strong evidence for comparable increases in the exploitation of wild olives at other sites after Shillourokambos and before Mylouthkia.

The adoption of new crops is also observed at Tenta, where the wild barley recovered in Period IV was supplemented or supplanted by morphologically domestic

strains in later levels. Oats may have been introduced in Period 3, though they are not at all well-represented, and their absence in earlier levels is unsure. The adoption of new crops may relate to changes in average size in the ovicaprine population which to some (Wasse 2007) suggests re-stocking from the mainland, preceding intensive investment in these grazers and reduced emphasis on deer.

At Khirokitia, paleobotanical data document a decrease in fig from Level III to Levels II and I. There is no corresponding decrease in fig in pollen cores; nor are there sufficient data to determine whether other sites relied less on figs at any point during their occupation. Khirokitia generally seems to have relied less on the complex of the most prevalent storable wild foods—wild olive, pistachio or lentisk, and fig—than any other Aceramic site; indeed less than any other site in the whole of the Early Prehistoric. Perhaps this is due in part to the availability of alternatives: hickory and hazel nuts, acorns from white oak (requiring less processing to remove tannins than red oak), carob, and cat-tails, or to unusually good relationships with off-island groups who could be relied on to provide aid.

As compared with the Aceramic, the Late Neolithic witnesses comparatively dramatic changes in the plant repertoire with the introduction of wild grape, chick pea, and apple. The latter may have failed, since it is not attested at any Early Prehistoric site after Vrysi, though apples are grown on the island today with the aid of irrigation. With such a small population of sites on which to base discussion, it is regrettable that flotation at Paralimni produced no results and that the results from Kantou have thus far noted only the presence of given taxa at the site, with little or no contextual

information⁸.

The data available from the Chalcolithic also tend to give the impression of conservative agricultural economies, dependent on cereals and legumes, but continuing to exploit a wide range of wild plant foods, both ordinarily and as part of diversification strategies for coping with bad years. Spuriously to infer conservatism in agriculture from data sets that often do not possess sufficiently high chronological resolution would be a serious mistake. Nevertheless, the available evidence strongly suggests such conservatism was a feature of at least Middle and Late Chalcolithic economies in the west, where most data are available. At Mosphilia, for example, both *Triticum monococcum* and *T. dicocum*, as well as bread or durum wheat (*T. aestivum/durum*), and barley (*Hordeum sativum*) were grown over the course of Periods 2-4. All periods yield lentils, vetches, fig, *Pistacia*, grape, and olive, the latter of sizes compatible with domestication (Murray 1998, Table 11.1). In summary, therefore, there was little to no notable decrease in diet breadth over the course of the Early Prehistoric in terms of the number of wild plant food represented. However, before drawing any conclusions it is essential to deal synthetically with the evidence of the animal economies and of local vegetation regimes.

In contrast to the paleobotanical data reviewed above, the animal economies of the Early Prehistoric exhibit considerable site-to-site variation and change over time. This variation is easier to quantify than that for plant assemblages: despite error

⁸ This will be rectified with Evi Margaritis' forthcoming publication of the paleobotanical data from Kantou, which unfortunately I have not been able to take into account.

introduced by depositional factors and taphonomic processes, the proportions in which different major taxa (deer, pig, caprines) are represented can be taken to reflect, more or less, the proportions in which they were exploited.

With regard to faunal assemblages, while the degree of spatial variation, measured by the difference in the relative representation of the primary taxa at different sites, is high, the degree to which that variation patterns spatially is apparently quite limited both at the site level and at the regional level. For example, while roughly contemporaneous sites may have very different faunal profiles, with pigs accounting for 6% of the meat consumed at one site and 30% at another, it is surprisingly difficult to identify examples of strong spatial patterning at the level of regions or ecological zones like those in the Levant, where sheep predominate in the northern Levant and goats in the south (Redman 1999, 108).

Cattle remains are limited to Early Prehistoric sites in the west of the island, and coastal sites are, unsurprisingly, more likely to have fish and marine mollusc remains. As Simmons and Croft have both suggested, the presence of cattle in the prehistoric west may be an artifact of their importance in the homelands of those groups who came to settle in western Cyprus, but that cattle were ultimately disadvantageous relative to other domestic species under the environmental and social conditions which obtained in western Cyprus (Simmons 2003). Therefore, the distribution of cattle is likely to be more a function of the groups who brought them than to reflect adaptation to local environmental conditions. Such an argument is open to critique on many levels, starting with concept of distinct *Urheimaten* and persistent

group boundaries at a time of high mobility and dramatic economic, technological, environmental and social changes. However, the available evidence points to the introduction of cattle to Cyprus from Anatolia, where they were a central feature of animal economies, in the 10th millennium BP, and a brief increase in their importance followed by a long but steady decline.

Turning to marine resources, it is obviously important to understanding economic strategies of Early Prehistoric villagers to make some kind of assessment of how important fishing was generally, and the nature of the exploitation of marine resources: how intensive it was, how specialized in terms of time and knowledge were the fisher folk, and how heavily villages might have depended on it to contribute to subsistence or protect against risk. Most Early Prehistoric village had some access to fish and shellfish, but as we will see, this access was not equal for all communities. The absence of marine shell and fish bones at Dhali *Agridhi* is easy to understand; their absence from Paralimni *Nissia* is more puzzling. Perhaps it is a recovery problem, though of course not all islanders or coastal people depend on fish: the traditional economy of islanders in the northern Sporades depended on herding, with little attention given to fishing (Sampson 2008). With regard to the recovery of fish more generally, applying a ratio like Croft's (1998, 212) for the amount of fish bone missed in ordinary excavation and screening suggests that fish, especially small fish such as might have been taken inshore, might be underrepresented by 90% or more in terms of elements identified. Large fish, like the 10-kilo groupers caught at Shillourokambos, are less likely to pass unnoticed, but their bones are probably still

underrepresented relative to those of deer, pig, sheep, and goat. Assuming fish of 0.5 kilo in weight are recovered at a rate of 5% in non-floated contexts, every fish element recovered outside flotation might represent 20 not found, or, if such fish are taken to yield 0.4 kilos of protein, 8 kilos of lean protein—not quite half that provided by a smallish fallow deer, which at Mylouthkia were recovered at a rate of nearly 40% (Croft 1998, 208, Table 10.2). These inputs are subject to debate, but it is easy to see how a substantial contribution to diet by fish, on the level of caprines or pig, could remain undetected. Additionally, certain techniques of consumption and preservation, such as filleting, consuming odd parts immediately (and perhaps off-site) in a fish stew or something like a risotto, and smoking or salting only the fillets, would exacerbate deposition and preservation bias.

It is useful to distinguish the products of several kinds of littoral and maritime fishing activities: the first, what might be called “coastal foraging;” the second, a variety of techniques of inshore fishing; the third, pelagic or off-shore fishing. The spatial distribution of these exhibits a degree of patterning throughout the Early Prehistoric. “Coastal foraging” involves the acquisition of a broad spectrum of resources (broad in aggregate: people may have focused intensively on individual resources at certain seasons) available in the littoral zone. These include certain marine molluscs, crabs, sea birds and turtles, their eggs, plant foods—seaweed and kelp both have nutritional value—and, potentially, sea animals either beached or washed up dead (a plausible source for the shark vertebrae from Paralimni). Such resources, especially limpets and topshells, which are better preserved in the

archaeological record, are ubiquitous both at coastal sites and further inland. This ubiquity is probably explained by the fact these resources yield valuable meat, cannot easily escape human predators, can be gathered in the littoral zone without specialized equipment, and the risk of coming home empty-handed was likely lower than fishing with a line.

Shore-based or near-inshore fishing probably produced most of the bony fish consumed by Early Prehistoric people. Groupers, horse mackerel and bass could have been taken inshore (Cerón-Carraso 2003, 256; Desse and Desse-Berset 1989). Inshore fishing, unlike coastal foraging, tends to be characterized by highly variable returns, though there are certainly circumstances where this is not the case, such as the highly productive annual salmon runs of the Pacific Northwest or the cod on the Great Bank and the coast of New England in the early days of Atlantic fisheries. Fish likely to have been caught inshore or from the shore appear at most Early Prehistoric sites for which data are available.

The products of pelagic fishing include small fish likely taken with nets, deep water species, and migrants like bluefin tuna which tend to remain offshore. Pelagic fishing represents the highest investment of time and energy in fishing technology, and the highest risk to life and limb, but the return on spatially concentrated resources, whether big shoals of sardines or tuna migrations, is potentially very high. There is evidence for the products of such fishing at Cap Andreas ((Desse and Desse Berset 1994, 340) and Chalcolithic Mylouthkia (Cerón-Carraso 2003, 256).

In short, while the products of coastal foraging and shore-based or inshore

fishing are found widely, including at inland sites, persuasive evidence for pelagic fishing is restricted to Cap Andreas and Mylouthkia. Additionally, pelagic fish like tunnies were processed in ways not found in the assemblages of inland sites like Khirokitia, where fish do not show indications of off-site processing: the full range of skeletal elements is present (Desse and Desse-Berset 1989, 225). From this it seems likely that the processed tunnies were not traded inland.

What does this mean for resource procurement at the level of villages, and exchange of marine resources? The Cypriot “Mediterranean fishing villages” of the Early Prehistoric were not highly specialized, since they exploited a full range of terrestrial animals and crops, but they do seem to have kept some maritime resources for themselves. While certain resources may be considered “common goods,” ethnographic data suggest that limits and group ownership of resources are common, and provide an important check against over-exploitation (Speck 1926; Gordon 1954; Kelly 1995). There is just enough evidence to suggest that such restrictions may have been necessary to prevent over-exploitation of marine foods in the Early Prehistoric: the reduction in size of the limpets at Ceramic Neolithic Vrysi and Chalcolithic Mylouthkia attests to conditions affecting not only those sites, but their near neighbors at Troulli and the Lemba cluster, respectively. Unfortunately, data are generally insufficient to identify any pronounced changes over time in the exploitation of marine resources.

As important as they may have been, and as interesting as their spatial distribution is, marine resources were not the single largest mainstay of subsistence at

any known Early Prehistoric site. Most calories derived from the plant and animal products of cleared agricultural land and open mixed forest in the vicinity of Early Prehistoric settlements. Many workers have speculated about the relationship between vegetation cover and the animal species exploited at Early Prehistoric sites. Some have assumed climax vegetation of mixed oak-pistachio-pine woodland in the vicinity of their sites and covering much of the island generally. However, where pollen data, seeds, and charcoal are available for Early Prehistoric settlement, they tend to suggest a preference from the Early Neolithic onwards for open meadows and mixed open woodland, locations at ecotonal boundaries offering access to a wide variety of microenvironments. However, it is not apparently the case that inland, upland sites are more likely than coastal ones to depend heavily on deer. There is no obvious relationship between local vegetation and degree of reliance on fallow deer.

In Chapter 3, it was suggested Ceramic Neolithic sites form into two clusters: those sites at which deer account for 70-80% of the faunal assemblage, and those at which deer are less than 50% of the faunal assemblage. This may be extended to the population of sites as a whole.

Deer > 70% of faunal assemblage by NISP: Philia-Drakos, Dhali-Agridhi, Paralimni, Sotira, Erimi, Ayious, Pamboules

Deer 50-70% faunal assemblage by NISP: Mylouthkia, Lemba

Deer < 50% faunal assemblage by NISP: Ais Yiorkis, Ortos, Shillourokambos, Cap Andreas, Tenta, Khirokitia, Vrysi, Kantou, Mosphilia

The spatial pattern identified by Legge at Vrysi, where the ratio of caprine to deer bones was twice as high on house floors as in fill and midden contexts (Legge 1982) was not observed elsewhere. Legge assumes that this reflects bias in preservation rather than consumption behavior, but I entertained the possibility that it might conceivably relate to greater numbers of deer consumed in outdoor communal consumption. However, at other sites where there is evidence for communal consumption, as at Mosphilia, there is no such spatial patterning in the animal remains.

It appears that smaller and shorter-lived sites were more likely to rely more heavily on deer, while larger and more established village sites had more diversified animal economies. The exceptions are the relatively large Chalcolithic sites at Lemba and Mylouthkia which, despite their spatial extent and presumably, correspondingly large populations, possessed animal economies concentrated on deer. This is an appropriate point to introduce the temporal dimension of Early Prehistoric animal economies, which immediately throws several trends into relief. Clearly, deer become more important over a long time frame, from the Aceramic represented by Shillourokambos (ca. 8200 BCE) to the Chalcolithic (ending ca. 2500 BCE). However, on a somewhat shorter temporal scale, and on a site-by-site basis, the importance of deer relative to other species tends to decrease over the course of site

occupations. The contrast between the patterns observed at these different temporal and spatial scales is explained below, in the section that deals with the fourth major question posed in this study, namely to what extent differences among villages are able to be attributed to the strategies on which they relied.

RESOURCE STRESS AND ITS DISTRIBUTION

The second set of questions to be addressed by this study concerned the nature of the sources of resource stress, and their distribution in space and time. Recent environmental and ecological research stresses the interrelated nature of ecosystems, such that change in one variable will affect many others. While high-probability guesses can be made about the nature of risks which existed in the prehistoric past based on conditions in recent history, these require some check in the archaeological record to build a robust argument. Therefore one of the goals of Chapters 3, 4, and 5 was to examine the archaeological evidence for evidence of both those stressors suspected from ethnographic and historical data, and hitherto unsuspected sources of stress. The presence of only some of those suggested stressors was supported by the evidence above, while other “hidden” stress factors were suggested to have existed in particular cases. Water availability, and ecological feedback loops in which humans and animals decreased the ability of the natural environment to support them, variable yields, and human and animal population dynamics all contributed to risk in Early Prehistoric societies.

It is worth quoting yet again from Christodolou's authoritative study of

agriculture in modern Cyprus: “The most serious problem in land use in Cyprus and the most fundamental in the economy of Cyprus is the intractable problem of rainfall variability” (1959, 28). There is good cause to believe that periodic changes in water availability constituted the major source of subsistence risk for Early Prehistoric agricultural communities as well. In the absence of canals or cisterns, Early Prehistoric farming is assumed to have been dry farming, at least as regards cereal crops (some vegetables and fruit trees may have been watered by hand). As we have seen, most Early Prehistoric sites fall in a zone that currently receives 400-500 mm of rain a year (Held 1992), roughly twice the 250 mm of rain/year often considered the bare minimum for successful dry farming of cereals (Gifford 1978; Briggs and Belz 1910, 188). Naturally, because a site receives 400 mm of rain today—or, more accurately, lies within a zone tending to receive this amount of rain—does not mean they did not enjoy greater rainfall in the early and mid Holocene. Additionally, as noted above, annual rainfall is not as important as soil moisture or the amount of rain that falls during the growing season (Christodolou 1959, Briggs and Belz 1910). But global circulation models (Robinson et al. 1996) suggest that rainfall, while higher in the Early Holocene and for a brief interval in the Mid-Holocene, was never so abundant or regular as to eliminate the risk of drought for dry farmers.

Neither the archaeological nor paleoclimate record provides sufficient resolution to evaluate the periodicity of drought, but taken together they suggest periods when individual sites may have had to accommodate greater interannual fluctuation in precipitation or higher frequencies of drought. Human activity also

affected, in absolute terms, the amount of fresh water and soil moisture, through well-digging, anthropogenic deforestation and erosion, terrace-building, and other landscape modification activities (Falconer and Fall 1995).

Drought affects not only crops, but herds and wild game populations (Forbes 1989; Forbes 2007; Legge 1989) and may tend to concentrate both domestic and wild animals near water sources. Severe seasonal water shortages reduce animal lactation (Forbes 2007, 240), affecting not only milk yields, but the health of young animals, and increase kid/lamb mortality, reducing and herds' ability to reproduce themselves (Gregory and Grandin 2007, 149). Age and sex profiles suggest Early Prehistoric herds and flocks were not managed primarily for the production of milk, and indeed human adults may have been unable to digest raw milk, as many Greeks and Cypriots are today. However, conversion of milk to yoghurt or cheese renders it digestible (Davis 1987, 156) and, equally important, cheeses like the traditional Cypriot *halloumi* can be kept in brine for many months, a store of protein and fat calories. Milk production was in sum an important variable, and the loss of young animals a real blow to the growth of flocks and herds—as attested by strategies which allowed relatively high numbers of juvenile males to reach a certain weight before being slaughtered.

Hotter, dryer summers and long-term aridification both affect vegetation. In the short term they may render plowed fields more vulnerable to erosion: where soil moisture is very low, wind-borne erosion is a problem, as in the Dustbowl of the 1920s in North America. Sometimes conditions stabilize as pressures on vegetation

promote a “scrub ecosystem” of spiny xerophilic plants resistant to animal browsing and grazing, or dry heath and meadow conditions (Redman 1999), which are indeed attested in the paleoenvironmental data from Early Prehistoric sites.

Variations in rainfall naturally contributed to variable harvests, but there were many other factors: tilling techniques; the amount of seed sown, where, when and under what conditions it was sown; the attention given to weeding, defense of the crop from animals; events like fire or locusts. The labor resources of communities varied in size and temporal availability.

Summer tillage is highly advantageous in regions with low annual rainfall, where most rain falls in the winter (Briggs and Belz 1910, 188). Traditional agricultural regime in Cyprus, however, often plants wheat and barley in the winter and harvests in midsummer. It is during summer that crops are at greatest risk of destruction by fire, which today is a perennial problem in Cyprus. In other parts of the world, goats are being used to control fire-susceptible vegetation (Gregory and Grandin 2007, 149). Crops were also at risk from animals: locusts, rodents, birds, and, not least, the deer on which Early Prehistoric communities depended so heavily. Peltenburg has suggested (1982a, 99) that dogs were introduced in part to guard fields from deer. This may have been a mixed blessing, if it resulted in a lower encounter rate and fewer chances for opportunistic hunting; on the other hand, farmers' willingness to accept the trade-off might reflect the relatively high importance of cereal crops compared with wild game.

Agriculture depends on the ability to allocate labor effectively to many

different tasks while deploying sufficient labor for certain critical tasks at certain critical times of year (Halstead 1987). Unpredictability in the availability of labor will also have constituted a source of risk. Households and communities had to deal with the loss of labor through mortality and illness. The prevalence of thalassemia in at least some Early Prehistoric populations suggests that malaria was endemic. In addition, people may have been unable to work due to injuries: any community that relies on hunting wild boar will sustain a certain number of debilitating wounds, while at least two individuals at Khirokitia recovered from injuries that suggest a human assailant. Population dynamics deserve consideration as a major variable in the nature of resource stress, at the level of sites and regions. The decline in *Cerealia* pollen in the later phases of the West sector at Khirokitia may just as easily reflect a decrease in community size corresponding to less land under cultivation as change in the productivity of local soils due to aridification.

At the level of the region, it should be considered whether episodes of abandonment represent a response to unworkable conditions: why people whose subsistence depended so largely on the crops and resources in a location they knew chose to incur the risks and hardships of moving. PPNB sites on the mainland experienced dramatic growth in size, which put real pressure on the resources of their local environments (Falconer and Fall 1995; Rollefson and Rollefson 1992). It is sometimes suggested that Cyprus was settled by farming groups because of population pressure on the mainland (Willcox 2003; Peltenburg et al. 2004). However, Clarke (2007) and Wasse 2007) have argued that Cyprus itself experienced low population

pressure throughout the Early Prehistoric. What this might reflect about the dynamic spread of farming technologies and populations is discussed below.

RISK BUFFERING MECHANISMS AND STRATEGIES

This brings us to the third question posed in the introduction: what features of subsistence practice helped to protect early villagers in Cyprus from the myriad risks they faced? Halstead and O'Shea (1989) examined such strategies in terms of mobility, diversification, storage, and exchange. Naturally, behavior may fit two or more of these descriptions at the same time; for instance, driving sheep to a neighboring community to trade for crops not normally part of the shepherds' diet. Careful attention to spatial and temporal scales of risk is required: seasons of low rainfall, bad harvests, longer-term site catchment deterioration, reduced availability of large game may have triggered different “nested” responses (Forbes 1989).

Several workers have observed (Halstead 1989, Kelly 1995) that some buffering strategies are complementary, while others are not so readily compatible. Reliance on stored resources, especially cereal crops, ties people to their crops and stores and complicates, if not wholly precludes, residential mobility. For people who rely on immediate-return strategies, including most foraging groups, mobility provides access to new sets of resources; for those like farmers practicing delayed-return strategies, residential relocation would be least advantageous in seasons of hardship, when they could least afford to invest in clearing new land, building new homes, and undertaking the hard work of niche construction. Note that this is largely a question of

scale: short-term stresses may be addressed by the generation of surplus while longer-term ones may be addressed through moving. For the farmers of the Early Prehistoric, abandoning villages and resorting to mobility seems to have been a strategy of last resort. Unusually, however, and more difficult to explain, is that once mobility responses were triggered, rather than the immediate establishment of new agricultural villages, relatively long periods of residential mobility seem to have ensued.

Certain features of early phases at Shillourokambos, Mosphilia, Mylouthkia, and all phases at Dhali and Ayious suggest relatively low investment in the construction of durable structures, which tends, across a large ethnographic data set, to correlate inversely with average frequency of residential moves (Kelly 1995). Extrapolating from these sites, the phases of the Early Aceramic represented by the Early Phase A at Shillourokambos, the early Ceramic Neolithic, and the Early Chalcolithic may all have been characterized by greater residential mobility.

Under most circumstances, agriculturalists achieve significantly higher population densities within a given region than did mobile foragers in the same region. As they fill up the landscape, farmers are effectively prevented from returning to foraging ways of life because they are too numerous and unable exclusively to exploit big territories. The Levant, however, is an area which is known to have supported both comparatively dense populations of mobile foragers and large communities of sedentary foragers in the Kebaran and Natufian periods (Moore and Hillman 1992; Moore et al. 2000). It is possible that conditions on Cyprus in the Early Prehistoric gave farmers there the option of resuming higher-mobility strategies incorporating

some agricultural technologies.

It is notable that subsistence practice at Ayious and Dhali and in the early phases at Shillourokambos and Mosphilia do not exhibit evidence for a broader spectrum diet than preceding or following periods, for overhunting, or with other plausible indicators of resource stress: rather the reverse. All these phases have in common a strong focus on one animal resource: pigs at Shillourokambos, fallow deer at Dhali, Ayious, and Mylouthkia (note also that the ephemeral site of Ayia Varvara *Asprokremnos*, which precedes the chronological range covered in this study, is characterized by a faunal assemblage dominated almost entirely by pig). The ages of the animals, like the range of wild plants recovered from these sites, does not point explicitly to purely seasonal occupation. Moreover, these sites seem to have been growing the normal range of cereal crops and pulses—wheat, barley, lentils—strongly suggesting that they were nascent villages, rather than temporary camps. At Shillourokambos, Mylouthkia, and Mosphilia, subsequent phases exhibit increasing investment in permanent architecture. Dhali and Ayious never developed into villages, but it seems likely that all these sites represent the end of periods of higher mobility which have left comparatively few traces in the archaeological record.

The various processes by which Early Prehistoric villages split, budded, grew, shrank, and were abandoned are obscure, though studies of assemblages have done much to elucidate abandonment and re-use (Peltenburg 1993, 1998, 2003, OTHER REFERENCES). Peltenburg argues (1998, 259), citing the Period 3A-3B spatial shift in settlement at Mylouthkia, that settlement shifts were “not always predicated on a

gradual emergence of a new order, with families budding off only to re-create essentially the same existence, but [could involve] a radical reinvention that involved the whole community.” Certainly other small-scale agricultural societies witnessed mobility “events,” as a dramatic but rarely used part of behavioral repertoire. Typically, however, once triggered, fissioning or mass emigration results in establishment of new villages (Bandy 2004) rather than in long periods of nomadism and settlement dislocation, as was apparently the case on Cyprus.

It is worth reiterating that people's mobility need not have been restricted to the island itself. The maritime connections that permitted human settlement on the island in the first place, and the exchange of ideas with the rest of southwest Asia—even if Cyprus did not follow in lock-step—represent personal relationships maintained over long distances. These might have furnished a safety net of last resort, especially for those members of Early Prehistoric societies most heavily invested in maritime technologies: the offshore fishermen of Shillourokambos and Cap Andreas.

Diversification strategies were ubiquitous throughout the Early Prehistoric, though they varied in their particulars from site to site and period to period. It was argued above that Early Prehistoric village sites tend to be situated in range of a variety of microenvironments offering different resources, from steppe forest to riparian zones. This is reflected by the frequency with which Held's site descriptions situate them at the interface of vegetation, soil and geological zones (1992). Strikingly, all of these sites from large villages on well-watered flood plains to ephemeral sites in the hills, bordered by pillow lavas and pine forest, maintained diversified subsistence

strategies incorporating cereal agriculture, pulses, wild plant foods, hunting, and stock-raising. Just as local environmental conditions were different for different sites, so the relative importance of all these activities differed; additionally, they changed over time, as reflected in the discussion above.

The use of resources that appear contemporaneous may disguise periodic use of certain resources on a time scale shorter than that measured by the archaeological record. However, because of the time scale involved in diversification into domestic animals and a range of crops, these are highly unlikely to represent a short-term response to a single dry season. In Cyprus, diversification, unlike mobility, was a widespread strategy for dealing with constant low-level variation, rather than a behavioral option triggered by unusual stresses. This is not to say, however, that sites were equally diversified, nor that they did not increase or decrease their diversification.

It is important to recognize that, as an everyday strategy, diversification imposed significant costs. The spatial separation of wild plant resources, and the spatial and temporal uncertainty involved in relying on game demanded increased travel time, and increased the risk that at least some crops would fail or produce mediocre yields and some hunting expeditions fail. This disadvantage may have been gradually moderated as people—who would have selected new sites with a good initial knowledge of the requirements of their founder crops (Willcox 2003)—learned which soils locally were best suited to which crops, where water sources could be used to refresh flocks or attract game, and as they modified the landscape to create more

productive niches for themselves and their domestic animals.

Sheep, goats, and pigs have different dietary requirements, different environmental impacts, and different rates of reproduction. Pigs reproduce quickly and piglet gain weight quickly, while one pair of goats can increase to 100 in 5 years ; one pair of sheep would only give 32 in the same period (Redman 1999, 100). Thus, a strategy in which households maintain all three species will, all else being equal, give a much lower rate of increase in the number of animals and a lower meat yield than one which concentrated on the quickest-reproducing, quickest-fattening animals—assuming no disastrous episodes of disease wipe them out.

The pursuit of diversification required that labor be divided at times when it would have been advantageous to pool labor for critical tasks. It demanded the investment of energy in specialized technologies and involved additional risks, sometimes to life and limb, as in the case of offshore fishing or hunting wild boar. However, despite all these disadvantages, diversification in subsistence resources was apparently highly adaptive. Why was this? Seeking out site locations at the interface of different soil and vegetation regimes, and exploiting a full range of foods, might have been essential precisely because Early Prehistoric people's daily mobility, and their ability to move heavy loads, was restricted by the absence of animal transport, which Halstead has argued was an essential feature permitting the pattern of dispersed landholdings which characterizes traditional agricultural regimes in many Mediterranean places (Halstead 1987). With lower ability than their modern counterparts to diversify their holdings spatially, Early Prehistoric farmers had a

strong incentive to seek out locations with a variety of microenvironments close at hand, and to invest in a wide range of plants and animals to take advantage of the properties of those microenvironments (cf. Figure 17, above).

Unfortunately, the nature of the data from Early Prehistoric sites preclude the compilation of a “bean ubiquity index” such as that used by Spielmann and Angstadt-Leto in their discussion of the relative importance of wild plant foods in the prehistoric Southwest (1996, 96-8). Spielmann and Angstadt-Leto found that prehistoric farmers in the American Southwest, under conditions of periodic drought not so very different from those in Cyprus, experienced very high variability in their access to large game, but that this was nowhere near so severe a risk as the periodic failure of crops. While the resolution of the botanical data for Early Prehistoric villages is poor compared with faunal data, wild plants can probably be taken to have been a key component of diversification strategies from the early Aceramic Neolithic through the Late Chalcolithic. Hopefully, detailed publication of plant remains from sites such as Ortos and Kantou will shed new light on their role, relative importance, and relationship to local environmental data.

Assuming that deer were hunted for most of the Early Prehistoric according to game management strategies which stressed sustainable culling practices, rather than penned or semi-domesticated (Croft 1993; Vigne et al. 1989), the dynamic between hunting and herding as components of diversified subsistence strategies is a complex and interesting one. In foraging societies such as the !Kung and Hadza, the pursuit of the highest-calorie packages, even where the risk of failure to obtain any food at all is

high, has been found to be advantageous for individual hunters and the group as a whole (Hawkes 1991; Hawkes et al. 1993). Livestock, however, have considerable advantages over hunted game from the point of view of risk management: a 100% encounter rate, effectively no search time, and no risk of coming up empty-handed. In addition, domestic animals reliably offer a range of different sized caloric packages, and the selection of smaller, younger males actually increases the resources (mothers' milk) available to younger females, increasing the breeding potential of the herd as a whole. Except in the case of raiding and rustling, farmers need not worry that their livestock will be eaten by others, and can plan to increase their holdings; while access to large game is often restricted through systems of hunting rights or territories, it is difficult for hunters to reliably multiply their future expectations of calories, except through building relationships of obligation (Hawkes 1990; Hawkes 1991; Hawkes et al. 1993; Kelly 1995). What features of hunting, then, made it worthy of retention as part of diversified subsistence strategies? It is not enough to say simply "people like to hunt," since if hunting incurred a sufficient cost *vis-a-vis* herding and farming, we might expect it to have disappeared, or to have become much less important as a source of calories, where in fact the reverse is true: Chalcolithic sites relied on hunted game as heavily, or more heavily, than their Neolithic predecessors.

Two key factors might be, first, the complementarity of micro-environmental zones and, second, an abundance of game. Where microenvironments in the vicinity of a site are better suited for hunting than for herding, i.e., where hunting in these patches provides as high a return on energy expended as on herding, and where hunting

strategies do not materially decrease the returns from hunting to the point where energy is better invested in agriculture and herding, hunting will remain a component of site economies. This is a difficult proposition to test, as it depends not on the presence of suitable deer habitat, but on the relative suitability of given environmental patches for hunting and herding, which, as already mentioned, may have changed significantly as Early Prehistoric people modified their landscapes.

Another reason why the continued pursuit of hunting might have been advantageous from a buffering standpoint is that livestock are subject to various diseases, some of which are inter-communicable (Gillespie 2004, 541-553). In the event of severe outbreaks of disease, farmers might have turned to hunting to alleviate pressure on domestic animals as they built up their flocks and herds again. Intermittent environmental pressures may also have encouraged hunting. Drought tends not only to reduce animal lactation, but to concentrate flocks and wild game at reliable water sources—Childe's oasis hypothesis for domestication (1939). This might have actually increased the predictability of encounters with deer, yielding a higher return, though the deer themselves would be likely to have depleted some of their fat reserves (Chapman and Chapman 1975).

Binford observed that Nuniamut hunters share “windfall” game, but not the generally reliable caribou, to which hunters have roughly equal access and of which every hunter is expected to take sufficient number to provision his family (1978). This situation is made possible because under Arctic conditions, caribou are a storeable resource: when families' caribou caches are raided by bears, as sometimes happens,

they become “eligible” for shared meat, both caribou and other game (Binford 1978). I have suggested a similar principle may have applied in Early Prehistoric societies, with private ownership and limited sharing of sheep, goats, and pigs, but deer more widely shared. I have suggested such an arrangement partly because I believe its likely effects would mitigate pressure on deer populations, and help explain why they were hunted in a fashion sustainable for millennia.

First, if hunted resources had to be shared, it would encourage agents to put more energy into flocks of which they and their families were the primary beneficiary. The exception might be aggrandizing individuals or groups, who might use shared meat to create relationships of obligation. In connection with this, it is worth noticing the high proportion of deer bones associated with the Pithos House. Second, public sharing of deer meat could enforce the advantageous selection of young males, since they would be on display to a significant part of the community. Spatial distributions of deer bone at the sub-site level at Khirokitia, Vrysi, Lemba, and Mosphilia suggest that either taphonomic processes affected the distribution of deer as opposed to other remains (Legge 1982), or that domestic and hunted animals may have been prepared in different ways and perhaps eaten disproportionately by different groups within the settlement.

The tremendous resilience of highly diversified strategies in the face of local environmental change and their flexibility in meeting the goals of farmers and households probably explain why such strategies were ubiquitous, but it is also important to consider increases or decreases in diversification at the site level, as

responses to less frequent but more severe stresses, such as periods of drought lasting several years, in the face of which normal responses from the behavioral repertoire proved inadequate, producing change in subsistence practice. Elsewhere in southwest Asia, the small animal component of faunal assemblages has been usefully interrogated for evidence of intensification and catchment depletion. Since small, fast animals like hares and lower-yielding wild plants provide a comparatively low return on energy, an increase in their representation at the expense of slow small animals like tortoises and larger packages like gazelle reflect a higher energy expenditure, which sometimes accompanies evidence for population pressure, deforestation, and other potentially stressful developments (Martin 1999; Munro 2004; Rollefson and Rollefson 1992).

Small mammals and avifauna are, as we have seen, chronically underrepresented in faunal assemblages on Cyprus (Croft 1998, 225), but the absence of evidence for rabbits or hares in assemblages from which the bones of cats, birds, foxes (which are small) and dogs are recovered is reasonably taken as evidence of their absence. This stands in contrast to the presence of marine resources such as fish and molluscs, especially those from the littoral zone, the popular topshells and limpets, which exhibit evidence for size changes reflecting human predation (Ridout 1982, 93-95;.Ridout-Sharpe 2003b, 248). Bony fish, too, seem to have been affected by human predation. Clearly more work remains to be done on the small animal component of Early Prehistoric assemblages. It would be interesting to know, for example, whether use of small, fast game increases at a particular site as the

representation of deer decreases relative to other large mammals.

Wasse suggested (2007) that at Khirokitia, catchment deterioration drove intensification through investment in ovicaprids, particularly sheep. I have raised some possible problems with this interpretation, but it deserves consideration, the more so since it parallels cases in the Levant where deforestation and local environmental degradation encourages increasing investment in pastoralism (Falconer and Fall 1995). Clearly, these are cases where diversification did not provide a solution to subsistence problems.

Along with diversification, the production and storage of surplus was clearly one of the most important buffering strategies for Early Prehistoric people. Diversification and storage were largely compatible and complementary: during relatively short term (e.g. seasonal) stress events, stored resources might help compensate for the lower overall returns likely to come from the exploitation of a broader range of plants and animals. Structures identified as “granaries” at Tenta and Khirokitia (Structure 34 at Tenta and Building 99 at Khirokitia. Structure 34, with an internal diameter of some 2m, might have held some 13 cubic meters of grain if its walls were 1 m high above the level of the raised floor and it was full up, a volume roughly comparable to that of the Period 2 pits at Mosphilia, which Peltenburg calculated might have held enough wheat and barley to support anywhere from 20 to 50 people for a year (1998, 241). The size of Mosphilia in Period 2, and its population, is uncertain, but it seems likely to have been more populous than little Tenta at 0.25 ha. There are therefore some grounds for arguing that Tenta might have placed greater

reliance on stored cereals than Period 2 Mosphilia.

There also seem to be some indications of household-level storage at Aceramic sites: the einkorn tentatively attributed to the collapse of the roof of Structure 85 at Khirokitia. The coexistence of large, centralized storage facilities and storage in what are assumed to be private residences or sub-units thereof⁹ would have profound implications for the nature of Khirokitian society. It is a possibility which cannot be confirmed at present, but still a salutary reminder that we cannot take as axiomatic that risk was managed entirely at the level of nuclear-family households at any point in the Early Prehistoric (cf. Flannery 1973).

In the Ceramic Neolithic, despite the introduction of ceramic technology, investment in storage is less evident. There are virtually no surviving traces at Dhali. Peltenburg noted that storage facilities seemed not to have been a major concern at Vrysi (1982, 99) and the published data do not favor their identification at Kantou or Paralimni Nissia. At Sotira, pits inside houses may have been used for storage, which was brought indoors along with food preparation and consumption. While the sizes of the largest closed ceramics shapes increased over time, in both size and quantity they seem better suited for serving food, more closely analogous to the stone dishes of the late Aceramic Neolithic than the massive pithos jars of the Pithos House.

Chalcolithic sites made very different use of storage. Ceramic technology continued to develop to the point where the production of large hole-mouthed jars and

⁹ see Bolger (2003, 25) and Jones (2008, 123-126) for different interpretations, which however accord poorly with the available evidence.

pithoi was routine. Most of the evidence for the physical storage of surplus occurs at the largest sites, those in the west of the island: Mosphilia, Mylouthkia, Lemba, Erimi. Of these Mosphilia is perhaps most interesting because it shows risk being managed at different levels: “communal” storage pits in Period 2; household level production and storage in Period 3A; storage on a larger scale coinciding with evidence for feasting associated with the ceremonial area in 3B; and in Period 4A the Pithos House, centralized storage and perhaps redistribution, and emergent hierarchical social structure; finally in 4B, compounds, weakly integrated self-sufficient production, processing and storage.

Throughout the Early Prehistoric, meat was most effectively stored on the hoof. The dynamic between hunting and herding has already been addressed above, under diversification. It is a point of some interest to determine when secondary products became important in the diet of prehistoric people on Cyprus. Conversion of milk to cheese renders it not only digestible by many individuals with mild lactose intolerance (Davis 1987, 156), but storeable: Halloumi cheese, a traditional Cypriot staple, will keep in brine for months. Secondary products might thus have acted to exacerbate material inequality; those households and kin groups which possessed flocks being able to store still more critical fat and protein (and perhaps salt), while minimizing their need to draw on the stored meat represented by their flocks. However, household and communal storage are so important for social change more generally that it seems best to defer discussion of this subject to the section on social change, below, and turn instead to exchange as a buffering mechanism.

Obviously, many kinds of exchange are possible; these all have potential to serve as buffers at different scales. Some involve only the immediate transfer of material, while others also involve the creation of relationships and obligations which may be structured in many different ways. The nature of the data for Early Prehistoric Cyprus make it useful to separate, for analytical purposes, intra-community and inter-community exchange.

The spatial dimensions of subsistence practice attested at individual Early Prehistoric sites indicate, at different times and in different settings, sharing with immediate kin groups or households, sharing with extended kin groups or affinals, and communal consumption suggesting sharing among a large number of community members. The existence of big granaries (see above) at Aceramic sites would imply a high level of sharing of one of the most important resources: dry cereals and/or pulses. However, other evidence suggests cereals were also kept within houses, perhaps in lofts, accessible only to members of the household. By the Ceramic Neolithic, there is strong evidence for private storage, preparation and consumption of food, especially at Sotira, where pits closely associated with individual structures, interior hearths, and ceramic storage vessels all point to storage at the level of houses. Whether households as social units might utilize more than one such structure, as in the Pacific Northwest (Coupland 1996), is presently unknown. It may be useful to consider the village societies of the Ceramic Neolithic as transegalitarian, insofar as substantial material differences among households produced *de facto* ranking, but this did not develop into permanent status distinctions with asymmetric power relations, as reflected in other

cases by the obvious mobilization of labor, differential mortuary treatment, spatial segregation, and so on (Price and Feinman 1995; Hayden 1995).

Periodic or localized stress events might have either accentuated disparities between those households which had accumulated substantial reserves, if they drew on these in such a way as to accentuate the disparities between themselves and their neighbors (Flannery 1972), or, alternatively, had a leveling effect in terms of material inequalities, if such surplus was distributed to families who had run short in such a way as to disguise who was rich and who poor, as in the Tewa case documented by Ford (1977) and described in Chapter 2.

While the exchange of labor for additional rations is a common feature of non-hierarchical societies, there are indications that it was institutionalized at some Chalcolithic communities, leading to the changes in storage at Mosphilia outlined above, where “standard” bowl sizes also suggest systematized redistribution under the control or supervision of a sub-group. It seems probable that the same group in Chalcolithic society used feasting to create relationships of obligation. These are often discussed in terms of emergent elites (Hayden 1996), but might as easily have been a form of social storage, an alternative strategy to the accumulation of physical surplus, akin in many respects to hunters “showing off” to enhance their fitness (Hawkes 1990, 1991). Of course, as Wiessner has argued, “many personal or group projects unfold under the umbrella of feasting, no matter what the proclaimed purpose of the event” (Wiessner 2001, 115).

Briefly, then, intracommunity exchange of surplus in the form of stored food

and livestock was structured by frameworks of subsistence practice writ large, labor, and relations among households and lineages. Such exchange served many ends other than buffering against localized or periodic resource shortages, and was actively manipulated, but there may also have existed institutions to encourage such exchange as a response to shortage: these are difficult to detect archaeologically, but community feasts may have been one example.

Peltenburg has suggested (1998) that certain durable items like polished axes may have been convertible to food in times of stress. At various Early Prehistoric sites, engraved pebbles have been recovered which were suggested to have functioned as tokens or proto-seals, especially in villages like Mosphilia where there is additional evidence for redistribution of surplus (Peltenburg 1998). Such tokens, like valuable goods convertible to foodstuffs, are frequently incorporated into systems of “social storage” (Halstead and O’Shea 1989). Their identification as tokens is highly speculative: they are mostly simple pebbles of locally available stone; the cross-hatching designs would be difficult to distinguish among and not terribly difficult to duplicate, at least to a degree that would satisfy a cursory inspection.

Evidence for long-distance exchange is generally difficult to separate from evidence for mobility. There is a strong possibility that the few durable objects which represent obvious imports to the island represent mobility less for the sake of trade than the maintenance of long-distance relationships in which the surviving objects were relatively incidental, gifts or trinkets included in the pack or the canoe at the last minute, perhaps alongside other more important goods such as livestock, oil, hides or

textiles. It is worth considering the relationship between imported goods and the relationships they represent, and independent evidence for stress. I have argued that early phases at Shillourokambos apparently reflect a case of relative affluence, to judge from the ways in which several kinds of wild game were exploited. The relatively high representation of obsidian at the site relative to later sites, particularly the Anatolian-style glossed obsidian crescents (Guilaine 2003), indicate that relationships between people at Shillourokambos and in mainland Anatolia were maintained in the absence of any obvious risk-buffering motive. The fall-off of obsidian at later sites has often been taken to reflect a decrease in contacts with mainland groups, though it is important also to consider change in lithic tool types and reduction sequences (McCartney 2004).

Khirokitia exhibits a decrease in the use of obsidian over time, but the presence of carnelian beads likely to have been derived from sources not on Cyprus persists (Le Brun 1997, 27). Additionally, if changes in the size of sheep in the later Aceramic do reflect replenishment of stock from the mainland, this is likely to indicate trade in subsistence-related goods which *might* have been used to offset local stresses and shortages.

Evidence from later periods is equally ambiguous, if not worse. If we accept for the moment that the smaller number and smaller size of Late Neolithic sites relative to Chalcolithic ones probably reflects a lower total population, and that this smaller number of people exerted lower pressure on the resources of the island and had greater ability to diversify beyond the ordinary bounds of their sites' catchment

area without stepping on neighbors' toes, then we might then expect exchange to have been less important as a buffering strategy in the Late Neolithic than the Chalcolithic. Ceramics from these periods, however, have been interpreted to reflect a broad ceramic koine in the Ceramic Neolithic and greater development of specifically regional styles in the Chalcolithic (Clarke 2001). This is *not* to imply that there was more exchange in the Late Neolithic than in subsequent periods; rather it suggests that exchange in decorated ceramics was not apparently driven by the need to obtain foodstuffs to offset resource stress, or by systems of personal relationships representing safety nets in case of such stress.

I have suggested that the spacing of Chalcolithic sites may indicate some level of pressure on agricultural land and deer hunting territories. It is possible that deer and surplus grain themselves were exchanged, but the energy involved in moving them long distances would constitute a significant energy costs, while deer remains exhibit no patterning suggestive of involved field butchery, often a prelude to long-distance transport. Presumably the energetic cost of moving flocks or herds would be considerably lower relative to the net calories involved.

The production and exchange of microlite and certain kinds of ceramics in the Chalcolithic may have tied some sites—particularly lowland sites in the southwest of the island—into networks of communication, exchange, and mutual support (Bolger et al. 2004). The smaller villages of the Drousha drainage and other upland areas, which were not found to possess such pottery, may have been able to “opt out” of exchange networks by virtue of their smaller size and geographic position, which provided them

with greater rainfall and less frequent episodes of severe drought. This suggested, however, requires evaluation against environmental and economic data from these sites.

While exchange within communities is a virtual certainty, and exchange between communities may have involved the transfer of foodstuffs as well as the maintenance of personal relationships which had real value for farmers and herders, it is difficult to estimate the impact of such exchange at any given time. Insofar as can be judged from the incomplete evidence reviewed above, in comparison with other buffering mechanisms and strategies such as diversification, long-distance exchange seems to have been practiced for reasons not primarily unrelated to buffering the effects of environmental variation, and to have had comparatively little impact on the outcome of stress events.

DISTRIBUTION OF MECHANISMS AND STRATEGIES

The fourth major question posed in Chapter 2 was how to explain the distribution of different buffering strategies, and the extent to which trajectories followed by individual villages can be attributed to their employment of various buffering strategies. As argued above, diversification was a persistent strategy over the course of the Early Prehistoric, while investment in storage facilities increased over time along with site sizes, aided by technological developments, particularly in ceramic production. Otherwise, Early Prehistoric villages clearly had very different life histories, environmental and social. At the same time, many seem to have been

subject to similar, cyclical processes, which were non-contemporaneous and operated primarily at the site level rather than at the level of regions. Finally, village size and community configuration—the availability of different resources locally, the relative proximity of neighbors, and so on, meant that the “same” buffering tactics might be applied in two villages with different results.

While the life histories of individual villages were sketched briefly in Chapters 3, 4, and 5, the question of their relative longevity was not taken up, due in part to problems in obtaining accurate date ranges from extant radiocarbon determinations (Clarke 2007, 13-22; Held 1992a, 166-7; Knapp et al. 2004; McCartney and Todd 2005). However, it is clear that some settlements, like Tenta, Kantou and Lemba, apparently had very long continuous occupations relative to others, such as Vrysi, where stratigraphy, artifact typology, and radiocarbon all suggest shorter occupations. It is legitimate to enquire whether these can be attributed to different buffering tactics, or to something else.

Figure 20. Durations of occupation at selected Early Prehistoric sites¹⁰

Tenta ca. 8100 - 5300 cal BCE, roughly 2800 years

*excluding later 6th millennium “squatter” occupation (McCartney and Todd 2005)

Khirokitia ca. 7300 - 5730 cal BC, roughly 1600 years

¹⁰ using earliest and latest calibrated dates at 1 sigma (taken from McCartney and Todd, 2005; Clarke 2007, Fig. 2.2 and 2.3)

Kantou ca. 5320 - 3800 cal BC, roughly 1500 years

Vrysi ca. 4350 - 4050 cal BC, roughly 300 years

Lemba ca. 3265 - 2205 cal BC, roughly 1000 years

Mosphilia ca. 4000 - 2400 cal BC, roughly 1600 years

Clearly, duration of site occupations cannot be taken to reflect relative success of buffering strategies: any number of other factors, including social ones, contributed to site longevity (Peltenburg 1993). While the sample is too small to test for statistical significance, and the fact some sites have more and better dates than others would complicate sampling, these date ranges provide weak negative evidence suggesting that larger sites were not in general either longer- or shorter- lived than smaller ones. Nor does longevity apparently relate to the emphasis placed at individual sites on storage or diversification, as assessed in non-qualitative terms. If the identification of Structure 34 at Tenta as a granary is accepted, this long-lived village might arguably have had the highest identified storage capacity for its size of any Early Prehistoric site, but Mosphilia's apparently greater emphasis on storage than its peers does not coincide with apparently greater longevity. Briefly, it appears that on Cyprus in the Early Prehistoric, villages' use of storage and diversification, as attested in the surviving archaeological record, bear little relation to how long the villages persisted or how large they grew.

Some broadly similar ecological processes relating to buffering apparently played out at individual sites in successive periods, not contemporaneously (and

therefore not to be assigned to unitary causes, environmental or otherwise). One was the radical re-orientation of economic strategies from the period of the initial foundation of a community to subsequent phases, most pronounced in sites' animal economies. Shillourokambos, Cap Andreas, and Vrysi all experienced different versions of this phenomenon. Another is the decline over time in the relative importance of fallow deer at individual sites, in different periods, even while Chalcolithic villages tended to rely more heavily on deer than Aceramic Neolithic ones. Cap Andreas, where deer steadily increased in importance, stands as the obvious exception to this otherwise ubiquitous trend. Such a decline is usually explained by investigators as decline in deer habitat, intensification of herding, with greater potential for intensification (Wasse 2007).

Village size has already been argued to bear an ambiguous relationship to the emphasis placed on various kinds of buffering tactics at the site level, over the population of Early Prehistoric sites discussed. It is worth considering whether settlement configuration helps to explain the distribution of buffering strategies: were sites with no known near neighbors better able to diversify into a wider range of wild plant and animal resources under stress conditions? Conversely, do sites in close proximity exhibit more or less variation in their buffering strategies than sites with no known close neighbors? With the restricted size and varying information quality of the data set, any answer to such a question must be provisional. Additionally, we know very little about the economies of the sites in upland areas of the Vasilikos valley or the Drousha and Stavros tis Psokkas watersheds. However, the general similarity of

the Lemba cluster sites in terms of their buffering strategies suggests

It has already been suggested that upland sites in the Drousha and Stavros tis Psokkas may have been able to “opt out” of exchange networks into which sites like Mosphilia and Souskiou were incorporated (Bolger et al. 2004) at least in part because they benefited from environmental conditions which made exchange. This is an alternative explanation to seeing them as economically marginal, on the periphery of the “central” Chalcolithic culture areas of the coastal lowlands and lower Dhiarizos River valley. More data are required to elucidate economic activity at these sites, their buffering strategies, and their relationships with better-understood village sites in the Ktima lowlands and elsewhere.

FARMING, FOOD WAYS, AND SOCIETY

The fifth and final major question posed in Chapter 1 is essentially in two parts, the first concerning the implications of subsistence practices and long-term risk management strategies on Cyprus for the spread of agricultural technologies and populations in the Early and Middle Holocene, and the second part the relationship between subsistence practice and risk-buffering strategies on the one hand, and social transformations, particularly marked increases in material inequality and the development of rank, on the other.

Cyprus as a regional case study has significant implications for the spread of farming in Southwest Asia (Bellwood 2009). First, it is worth noting that people were present on Cyprus before the spread of farming, in the Epipaleolithic and Cypro-

PPNA (Simmons 1999; McCartney et al. 2007; Ammerman et al. 2008). In the latter case, it is not a question of ephemeral or seasonal coastal sites, but of apparently permanent populations exploiting well-known resources over large areas of the interior. It is not, therefore, the case that only Neolithic subsistence techniques permitted the permanent colonization of Mediterranean islands (Cherry 1981).

The degree to which a Neolithic Demographic Transition resulting from higher reproductive rates in the context of sedentary cultivation drove the spread of farming remains an important question (Ammerman and Cavalli-Sforza 1973; Bocquet-Appel 2009; Gage and DeWitte 2009). Population pressure on the mainland has been cited as one factor contributing to the settlement of farming groups on Cyprus (Willcox 2003). However, loss of coastal habitat due to marine transgressions may also have been important (Peltenburg et al. 2001; Peltenburg et al. 2004). Clarke (2007) and Wasse (2007) have argued that Cyprus itself experienced low population pressure throughout the Early Prehistoric. Sites remain small and spaced out. However, the high birth and mortality rates reflected in Early Prehistoric cemeteries approximate those elsewhere in southwest Asia, suggesting roughly similar demographics (cf. Bocquet-Appel 2009). It is generally accepted that what Bocquet-Appel calls fertility energetics (2009, 657) are altered by shifts in subsistence. But the example he uses of a decrease in the percentage of venison to wheat and maize is thrown into a different light by the Cypriot data, where the contribution of lean protein (fallow deer) increases over the course of the Early Prehistoric, with very high reliance on deer in the Chalcolithic, coincident with an apparent increase in population. Closer study of demography and

reproductive energetics on Cyprus would likely improve models for agricultural population dynamics elsewhere.

Shennan has proposed that an Ideal Despotic Distribution model may be useful for understanding the spread of agricultural populations. Groups would select the best available patch within their current region until the point at which patches in adjacent region were equally good or better. IDD does not specify what makes the best patch the best- e.g., highest potential for return on energy input; but it does assume agents have good information about other patches. This has the advantage of explaining why agriculturalists do not “fill up” a landscape—a phenomenon evident on Cyprus, where the earliest agricultural communities (Shillourokambos, Mylouthkia, Tenta) were widely separated.

The phenomenon of “niche creation” identified above complicates IDD models. If agents act to change the quality of patches, not only their own, but neighboring patches (by, for example, hunting deer in those patches), and if these changes are not known to other agents, then the information structure enabling patches to be selected in order of quality is abrogated.

I argued above that the Neolithic and Chalcolithic farmers of Cyprus operated under a range of local environmental conditions, necessarily starting with incomplete information (uncertainty, in the sense used by Winterhalder et al. 1999) about local environments in the vicinity of new settlements; gradually obtaining more information about the nature of risk while acting to modify landscapes. The Early Prehistoric is a record of the adaptive potential of early agriculture, and of early agriculturalists'

ability to transform local environments over generations. Rather than “fading into the background” (Wasse 2007, 62), agriculture was incorporated into conservative and resilient strategies at nearly every Early Prehistoric site.

Disparate outcomes for food producers have often been invoked as a factor driving the emergence of social inequality. Some workers approach this only from the standpoint of differences in production, but it should be clear that those households which successfully minimize their losses also enjoy differential advantage *vis a vis* other households, provided this advantage is not redistributed to other community members with no tangible gains for its original owners (Sahlins 1972). If, on the other hand, certain households or lineages can manage the redistribution of their stored resources in such a way as to accrue tangible benefits, such as debt obligations (Dietler and Hayden 2001; Hayden 1995; Hayden 1996; Hayden 2009), which can in some cases be managed to create persistent differences in status. On the other hand, Hegmon has observed, with reference to the American Southwest, that essential features of subsistence (reliance on corn) did not change at times of profound social change (Hegmon 1996, 224), while Forbes (1989) found that among modern farmers in the Methana, buffering mechanisms on the whole promoted social conservatism and tended to retard the pace of social change.

Whether buffering strategies act to amplify or reduce deviation in systemic terms (Maruyama 1963) depends largely on context. The case of Cyprus suggests “pinch points” where the structure of stresses change more quickly than the ability of buffering strategies to be triggered, modified, or rejected. Many stress events,

particularly those whose periodicity and severity fall within a “normal” range (droughts spaced at 5-10 year intervals and lasting a single summer), may not have a significant impact on social structures. Buffering mechanisms are adequate to deal with them, and households or social units do not experience vastly different outcomes; their relationship in terms of relative material inequality remains essentially unchanged.

Other stress events, however, produce a wider range of outcomes. Consider a hypothetical 3-year drought in which the wheat harvest fails twice, leaving many farmers without any reserves of wheat for consumption or for seed, falling back instead on wild stands of barley: herds are decimated, but sheep suffer much worse than goats. Those households which have seed to plant and whose goats survived are now in a significantly better position than their neighbors who had limited reserves of cereals and were heavily invested in flocks of sheep. Under these sets of conditions, some normal buffering strategies have the potential to exacerbate social differences, provided aggrandizers are able to circumvent leveling mechanisms which egalitarian and even transegalitarian societies use to moderate material inequalities and prevent differences in status from becoming institutionalized. Physical storage of surplus and social storage of obligations have received the most attention, as subject to accumulation and manipulation, but this is no less true of various forms of diversification, mobility, and exchange. While a full discussion of the implications of buffering strategies for the creation of social inequality falls (thankfully) outside the scope of this study, several points may be raised.

I have already commented on the potential for certain kinds of mobility, such as village fissioning, to produce strong inequalities as some community members remain in place with their stores, houses, and fields intact, while others are burdened with the energetic costs of moving their stores, establishing a new village, perhaps in a less desirable area, clearing and tilling fields, and all the hard work of “niche creation.” Participation of systems of exchange including subsistence commodities was obviously important for emergent elites in many times and places. Cyprus, at least in Early Prehistoric, is frankly not the best data set for understanding how elites manipulated exchange networks. Better data is available from later periods.

Feasting and communal consumption in the Early Prehistoric deserve discussion, as being closely related to subsistence practice and often implicated in the machinations of aggrandizers and emergent elites (Dietler and Hayden 2001; Hayden 1995; Hayden 2009). While suggestive evidence is available from Neolithic sites, by far the best evidence derives from the Chalcolithic, particularly from Mosphilia, where the feasting tradition attested in the Red Building's assemblage of serving vessels and the ovens of the Ceremonial Area can be justifiably argued to have culminated with the concentration of stores in the Pithos House before the apparent reestablishment of households' or sectors' autonomy in Period 4B. Benefits derived by feast sponsors may be fleeting unless they take steps to capitalize on their position (Hayden 2001).

Attempts to understand ritual in terms of its effects on humans' ecological relationships with their environment (the classic study is Rappaport 1967) are now often dismissed as intellectually old-fashioned. Certainly environmental regulation is

not the only role ritual plays in structuring society, but to ignore its ecological effects is decidedly ill-advised. As a component of buffering strategies, ritual can promote strategies which have been effective in the past, effectively preserving ecological information over long periods of time (Minc and Smith 1989). Ritual is frequently used to attempt to control those environmental factors such as rainfall which are effectively outside the realm of technological control (Marcus 2008). Ritual may also help to smooth intra-community tensions and increase cohesion, though it is equally capable of being co-opted by factions or aspiring elites. The apparent intensification of ritual in Late Aceramic Neolithic, Middle to Late Chalcolithic, at sites likely to have experienced the most pressure from both scalar social and environmental stresses (i.e., Khirokitia, Mosphilia) may be more than coincidental.

CONCLUSION

In the preceding pages, close examination of the risks faced by Early Prehistoric villagers and the means they used to reduce the potential impact of these risks has consistently highlighted the importance of local ecological factors generally, and the possibility for multiple workable strategies tailored to local environments. While much early scholarship on the environmental dimensions of the Early Prehistoric assigned sites to broad geological and vegetational zones, archaeologists generally and especially those involved in regional studies should be aware of the importance of documenting geology, hydrology, range of plant and animal habitats in as much and as fine-grained detail as feasible. Even at sites like Khirokitia where the

paleoenvironmental record has been studied in depth for many years from a variety of scientific perspectives, still more paleoenvironmental data are required to clarify the picture, while the dearth of regional survey data precludes many conclusions about how much space Khirokitia's farmers enjoyed.

Future research at Early Prehistoric sites will document the transition from the Aceramic to the Late Neolithic and from the Late Neolithic to the Chalcolithic in better detail, allowing better investigation of how subsistence practices operated in periods of more than usually intense social change or transition which appear to us disjunctive: for example, the end of the Aceramic Neolithic and the beginning of the Late Neolithic. This in turn will provide essential background for the impact of the revolutionary changes in agricultural practice which occurred in the Philia phase and the Early Bronze Age of Cyprus: the reintroduction of cattle, for meat and traction, plow agriculture, an increased emphasis on olives and grapes, all within a milieu of marked social inequality and emerging rank (Manning 1993; Keswani 1999; Steel 2001; Knapp 1994).

It might seem paradoxical, after drawing attention to the importance of purely local factors, to urge still closer engagement with scholars working throughout southwest Asia, but just as, on a modest scale, the comparative ecology of farming villages in Cyprus has shed light on the complexity of these systems; so studying the whole range of variation in village societies in the Levant, Anatolia, and further afield will ultimately yield a better understanding of their common problems and the complexities of life in early farming communities.

TABLE 2. SUMMARY OF REPRESENTATION OF MAJOR TERRESTRIAL
ANIMAL SPECIES AT SELECTED EARLY PREHISTORIC SITES

Shillourokambos (Vigne et al. 2003, 240, Table 1)

Early phase A (ca. 8200-7800 BCE)

deer 13% NISP

pig 74% NISP

caprine 9% NISP

bovine 3% NISP

Early phase B (ca. 7800-7500 BCE)

deer 40% NISP

pig 24% NISP

caprine 27% NISP

bovine 9% NISP

Middle phase (ca. 7500-7200 BCE- data lacking)

Recent phase (ca. 7200-7000 BCE)

deer 27% NISP

pig 25% NISP

caprine 46% NISP

Ais Yiorkis (Croft 2003, 274)

deer 44.5% NISP

pig 38.2 % NISP

caprine 16.1% NISP

bovine 1.2% NISP

Ortos (Croft 2003, 275)

deer 20.8% NISP

pig 29.8% NISP

caprine 49.4% NISP

of which 77% sheep, 23% goat

Dhali Agridhi (Carter 1989, Table 4; Croft 1989, Table 1)

deer: Carter: 79.8% NISP; Croft NISP 77.2% ; Croft MNI 68.9%
pig (*Sus scrofa*): Carter: 6.5% NISP ; Croft NISP 8.6% ; Croft MNI 13.3 %
caprine: Carter: 13.7% NISP ; Croft NISP 14.2% ; Croft MNI 17.8 %

Tenta (Croft 2005, 342 and 347, Tables 103 and 105b)

deer 38.9% NISP, 54.1% meat weight
pig 32.8% NISP, 37.1 % meat weight
caprine 28.0% NISP, 8.8% meat weight

Period 4 (Croft 1991, Table 1)

deer 63.2% meat weight
pig 30.0% meat weight
caprine 6.9% meat weight

Period 3 (Croft 1991, Table 1)

deer 42.7% meat weight
pig 50.2% meat weight
caprine 7.1% meat weight

Period 2 (Croft 1991, Table 1)

deer 48.3% meat weight
pig 43.0% meat weight
caprine 8.6% meat weight

Khirokitia (Croft 1991, Table 1).

Level III

deer 47.2% meat weight
pig 34.3% meat weight
caprine 18.5% meat weight

Level II

deer 36.7% meat weight
pigs 35.7% meat weight
caprine 27.6% meat weight

Level I

deer 19.3% meat weight
pig 26.7% meat weight
caprine 54.0% meat weight

Philia Drakos (Croft 1991, 69)

deer 71% NISP
pig 17% NISP
caprines 11% NISP

Vrysi (Legge 1982b, Table 5)

deer: 45.1 % NISP

pig 10.3 % NISP

caprine 41.7 % NISP

Early Phase (Legge 1982b, Table 4)

deer 8.6% NISP

pig 8.6 % NISP

caprine 74.1 % NISP

Nysia (Croft 2008, 101)

deer 77% NISP

pig 4.1% NISP

caprine 16.7% NISP

Erimi (Croft 1981; 1991, Tables 2 and 3)

deer 70.1% NISP, 86.2% meat weight

pig 9.3% NISP, 8.9% meat weight

caprine 14.4% NISP, 4.9% meat weight

Ayious (Croft 2004, Tables 37 and 39b)

deer 70.1 % NISP, 81.8% (meat yield)

pig 9.3 % NISP, 13.3% (meat yield)

caprine 14.4 NISP, 5.0% (meat yield)

Kalavastos Pamboules (Clarke et al. 2007, 71)

deer 72%

pig 13%

caprine 15%

Lemba (Croft 1985a, Tables 59 and 126)

Area I

deer 66% NISP, 73.5% meat weight

pig 16.4% NISP, 20.9% meat weight

caprine 17.6% NISP, 5.6% meat weight

Area II

deer 40.0 % NISP, 46.4% meat weight

pig 33.9% NISP, 44.8% meat weight

caprines 26.0% NISP, 8.6% meat weight

Mylouthkia (Croft 2003d, Tables 20.12, 20.14)

Period 2

deer 54.8% NISP, 74.9% meat weight
pig 24.1% NISP, 17.1% meat weight
caprines 17.1% NISP, 8.0% meat weight

Final Period 2

deer 47.4% NISP, 64.1% meat weight
pig 40.1 % NISP, 33.0% meat weight
caprines 8.1% NISP, 2.8% meat weight

Period 3

deer 40.2% NISP, 56.1% meat weight
pig 51.5% NISP, 41.6% meat weight
caprines 5.3% NISP, 2.2% meat weight

Mosphilia (Croft 1998, Table 10.1.)

Deer 38.7% NISP

Pig 40.8 % NISP

Sheep/Goat 17.7% NISP

Period 3A

deer 73.1% meat weight
pig 18.7% meat weight
caprines 8.1% meat weight

Period 3B

deer 56.8% meat weight
pig 37.2% meat weight
caprines 6.0% meat weight

Period 4

deer 45% meat weight
pig 46.8% meat weight
caprines 8.2% meat weight

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