Economy and Environment in Complex Societies: A Case Study from Bronze Age Sardinia

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 and Anthropology)
in the University of Michigan
2013

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Dedication

In loving memory of Geneva and Joseph Van Balen

Acknowledgements

Writing this dissertation would have been impossible without the help and support of a large number of people to whom I owe an enormous debt of gratitude. First and foremost, I would like to thank my family - Mary van Balen, Rick Holt, Jennifer Holt, and Kathryn Holt - for believing in me, supporting me, and - when necessary - tolerating my excesses of both enthusiasm and despair. They have watched me struggle to achieve my childhood dream of becoming an archaeologist, and have always been ready with their encouragement and love. I would also like to thank my grandparents - Geneva and Joseph Van Balen and Betty and Firman Holt - for always wanting to hear my stories and see my pictures; it meant the world to me.

I would still be struggling to put two chapters together without the support and advice of my co-chairs - John O'Shea and Sharon Herbert - and my dissertation committee - Robin Beck, Joyce Marcus, Lauren Talalay, and Nicola Terrenato. I have benefited enormously from their wisdom, experience, suggestions, comments, and criticisms.

I also owe a great deal to many other University of Michigan faculty who have helped and supported me. My sincere thanks to Kent Flannery for his advice, constructive criticism, and great stories; I feel lucky to have had my desk in the Zooarchaeology Laboratory all these years. My deep thanks also to Carla Sinopoli and John Speth, who always took the time to give me comments and advice; to Lisa Young, whose constant support has been invaluable; to Richard Redding, who introduced me to zooarchaeology; to Henry Wright, who has always encouraged my work in Sardinia and who has provided many valuable insights; to Jeff Parsons, whose support during my early days in the Museum was crucial; to Laura Motta, who has been an inspiration to work with; to Bob Whallon for his constant collegiality; to Elaine Gazda, who has always been immensely supportive; to David Potter, who has come to my aid many times; and to H. D. Cameron,

who provided the example of an inspired teacher that I hope to live up to.

My friends and fellow graduate students have provided a constant source of intellectual challenge, encouragement, and support. My deepest thanks go to Seth Button, my dear friend and colleague, without whom I could never have made it through graduate school. I owe an enormous debt to Taco Terpstra, whose love, support, and advice have been essential, especially while writing the dissertation. My deep thanks also to Amy Nicodemus, Amanda Logan, Lindsay Ambridge, Ashley Lemke, Colin Quinn, Lacey Carpenter, and to many other friends and colleagues too numerous to mention here.

The fieldwork in this dissertation would not have been possible without the enthusiasm, encouragement, and help of my colleagues and collaborators in Sardinia. Most importantly, I owe an enormous debt of gratitude to Mauro Perra, a great friend and colleague and the Scientific Director of Progetto Pran'e Siddi. My fieldwork would have been impossible without his enthusiastic help, tireless support, and invaluable advice, and together I think we made a pretty fantastic “disaster.” I also owe my sincere thanks to Mario Vacca for his expertise as a draftsman and his amazing patience with my imperfect grasp of Italian. Many thanks also go to Marco Pisanu, former Mayor Siddi, for believing in Progetto Pran'e Siddi and for providing the financial support that turned our idea into an excavation, not to mention letting us borrow his car during that first, experimental excavation season. The project would never have seen a successful conclusion without Stefano Puddu, the current Mayor of Siddi, who also gave the project his full support. Many thanks to my diligent workers – Daniela Abis, Tosella Abis, Otello Uras, Gianpaolo Floris, and Cristiano Cau - who did an excellent job and learned to smile at the strange demands of the American archaeologist. Finally, my heartfelt gratitude to my friends in and around Siddi - Mimmo Atzori, Annaluisa Mugnai, Carmen Pisano, Raffaela Scano, and Davide Uras, among many others - who have made it my second home.

My field project was organized and begun during a Fulbright IIE spent in Villanovaforru, Sardinia. I will always be deeply grateful to Mariano Pistis, former Mayor of Villanovaforru, for making me feel welcome in his *comune* during my Fulbright year, and to my wonderful friends Veronica Pistis, Silvia Pilloni, and Enrica Ibba, who made my stay in Villanovaforru so much fun. Many thanks also to Marco and Angela Figus and their wonderful family at the Hotel Funtana Noa, who watched out for

me, took care of me, and made me one of their family.

A number of international volunteers also made the fieldwork in this dissertation possible. I am particularly indebted Anne Dighton, who was an amazing lab manager, friend, and confidant; Bridgid Purcell, who was exceedingly generous with her time and talent as project artist, not to mention with her enthusiasm; and Kirsten Bradely, whose phenomenal excavation skills moved the project forward immensely. I would also like to thank Jamie Baird, Jessica DeJong, Jane Gagne, Jordan Gavin, Jana Mokrisova, Victoria Moses, Alina Naujokaitis, Susan Palazzo, Karynn Schmidt, Allison Ripley, Aurelien Tafani, Ariel Taivalkoski, Kayla Waldron, and Andrew Weiland for volunteering their time.

Finally, I would like to thank the specialists not previously mentioned for contributing to what I hope was an exciting new area of study; my sincere thanks to Andrew Fairbairn, Anke Marsh, and Robyn Veal for their excellent work and collegiality.

The work in this dissertation was made possible by a number of grants and generous donors. I would like to gratefully acknowledge the Fulbright Association, the National Science Foundation Dissertation Improvement Grant, the Joan B. Kessler Award, the Rackham International Research Award, the Redding Vehicle Fund, the James Bennett Griffin Scholarship Fund, the Etruscan Foundation, the John Griffiths Pedley Travel and Research Fund, and the Richard I. Ford Award for Anthropological Research on Humans and the Environment.

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Chapter 1: General Introduction

In the October 2011 issue of *Anthropology News*, Stephen Nash published a now much-discussed editorial in which he argued that archaeology cannot contribute to understanding or solving the world's contemporary sustainability problems. He founded this criticism on the fundamental incomparability of any portion of the human past with the human present on the basis of two incommensurable factors: scale, measured in absolute population, and the rate of technological change. "Compared to human societies of the past," Nash wrote, "human society today is simply unrecognizable and, I would argue, not comparable (2011:34). Nash criticized superficial attempts to compare population growth between the contemporary world and ancient urban societies and concluded forcefully: "I am unaware of a single archaeological case study that could be successfully and meaningfully applied, in a non-trivial way, to the discussion of sustainability in the 21st century."

While I think it would be rash, and as-yet undemonstrated, to insist that archaeology has much to contribute to solving contemporary global sustainability problems, I do think that Nash's despair of archaeology having anything to offer to the debate is premature and based on rather superficial comparisons of just the type he criticizes. I doubt any archaeologist would disagree that the contemporary human situation is indeed incommensurable with all past human experience when evaluated according to Nash's two criteria of population and technological change; however, I do not consider the necessary points of comparability to be scale and rate of change. Rather, I think the essential points of comparison are among human decision-making processes, and at least some archaeologists would agree that the archaeological record contains numerous examples, broadly speaking, of humans coming up with similar reactions to similar problems.

The current work is an attempt to understand the problems that underlie

sustainability issues at their root, which I take to be the initial formation of a society in which unequal access to resources is recognized as legitimate. This work assumes that many of the desires, goals, and pressures experienced by humans in a society of unequal access are cross-culturally similar, an assumption I consider to be well-founded based on the ethnographic and archaeological record. I do not think there is only one developmental path that an unequal society can take, and I do not think that sustainability problems are inevitable in a society of unequal access; the specific historical trajectories of individual societies are contingent upon any number of social, economic, and environmental particulars. However, I do think that the decision-making processes inherent in such societies can be modeled, that they can be placed within a social, economic, and environmental framework, and that points of potential internal stress based on sustainability problems can be identified. I also think that a critical understanding of sustainability problems as an intersection of conflicting feedback and decision making processes will have relevance for thinking about contemporary situations and strategies. Very much *contra* Nash, I think considering the problem at a smaller scale and a slower rate of change - essentially simplifying the problem - can make the problem clearer, not simply render it incommensurable.

The current work is presented in two sections. Section I, Chapters 2-3, provides the theoretical foundation for the work. In Chapter 2, I begin by developing a theoretical basis for thinking about the initial development of unequal societies and the subsequent consolidation, growth, and maintenance of social complexity. I see the development of social complexity as creating a particular kind of political economy in which the goals and constraints of the elite and non-elite segments of society become separated and differentiated. These different goals and constraints then have the effect of introducing tensions into the economy which must be resolved in order to maintain social complexity at a given level. The potential for non-elites to use mobility as a form of resistance and the availability of resources are identified as the key constraints which affect elite strategizing. My theoretical discussion focuses on the functioning of the political economy from the elite perspective, where maintaining or increasing social complexity is taken as the goal. While I think this assumption accurately reflects most conscious elite behavior in complex societies, I recognize that it does not reflect the agency of non-elites

very effectively. Chapter 3 builds on the theoretical discussion of Chapter 2. In Chapter 3, I present a general model of how elite strategies respond to the identified key parameters of producer mobility and resource availability to try to maintain and grow social complexity.

Section II, Chapters 4-10, applies my proposed model to an archaeological case study, the development of the Nuragic culture during the Middle Bronze Age of Sardinia. The early development of the Nuragic culture provides an excellent case study for several reasons. A large amount of settlement discontinuity between the Middle and Late Bronze Age indicates competition among early Nuragic elites and varying degrees of success in aggregating and maintaining power. Difficulty in aggregating power suggests that the interaction of producer mobility and resource availability may have occurred in such a way as to cause sustainability problems. Locating the precise nature of these interactions becomes a subject for further research. Evidence for producer mobility can be compared against evidence for resource use to identify precisely how these problems occurred. In particular, soil resources can be fragile in Mediterranean environments especially under certain climatic conditions, meaning that the Nuragic culture was potentially susceptible to an important form of resource overuse.

Chapter 4 serves as a general introduction to Section II, introducing the case study. In Chapter 5, I discuss the geology, hydrology, and climate of Sardinia in general and specifically of the Siddi Plateau area, the location of the settlement system used to test my model. This chapter locates the case study within its geographical and environmental context. In Chapter 6, I discuss the culture history of Sardinia as understood from previous research to situate the case study within a cultural framework. In Chapter 7, I discuss previous research on the Middle Bronze Age Nuragic community on and around the Siddi Plateau, and I describe the research design, outline the research methodologies for the excavation and survey, and discusses the basic findings of the project, including parts of the project that failed to return the hoped-for results.

Chapter 8 analyses the results of my new archaeological research in detail, relates them to the settlement history of the Siddi area, and interprets them in terms of the proposed model. Chapter 9 relates the results of my work on the Siddi Plateau to broader questions involving the Sardinian Middle Bronze Age, the early development of the

Nuragic culture, and the overall trajectory of the Nuragic culture including the drastic changes it experienced toward the end of the Final Bronze Age. It then discusses the relationship between the Nuragic society and the more complex societies of the East Mediterranean as well as Sardinia's role in the pan-Mediterranean events of the Bronze Age. Finally, Chapter 10 provides a general conclusion to the work as a whole.

Section I

Chapter 2: An Economic Perspective on the Emergence and Maintenance of Social Complexity

INTRODUCTION

The emergence of social complexity in a previously non-hierarchical society is a pervasive change that fundamentally alters a society's structure. Identity and belonging are redefined, creating new rights and responsibilities that are differentially distributed among a society's members. Included among these changes is a reordering of the conception and practice of economic behaviors. These new economic structures are often so effective in redirecting and concentrating the flow of a society's resources that identifying unequal distributions of labor and goods is one of the primary ways archaeologists identify social complexity in the past (Peebles and Kus 1977; Wason 1994). Village communities, each house similar to the next, each containing similar quantities of both staple and wealth items, sometimes become communities with economic distinctions: big houses versus small houses, many goods versus few goods, wealthy graves versus poor graves.

This chapter aims to understand the emergence and maintenance of social complexity from an economic starting point. I take unequal access to resources to be the economic indicator of a society's level of social complexity and the maintenance or strengthening of unequal access to be the primary goal of a complex society's elite: my overall theoretical framework is therefore essentially Marxist, following in the tradition of archaeologists such as Childe (1952), Adams (1966), Flannery (1969), Gilman (1976), and Earle (1997). I divide the chapter into three main questions and my attempts to understand them using archaeological and ethnographic data. In the first section, I address the question "how can a political economy in which some members of society have restricted economic rights emerge from an economy in which all members have full

economic rights." Second, I address the question "how is the political economy of social hierarchy maintained." Third, I address the question "what are the long-term consequences of maintaining an economy of social hierarchy." In my analysis, the potential for individuals to use mobility as a form of resistance emerges as a key factor influencing how economic structures change in egalitarian and transegalitarian societies. I also develop the concept of social value, which I define as the extent to which any object or behavior can be used to motivate loyalty, cooperation, and compliance and explore social value as the currency that is being manipulated in political economies. Finally, I place the economics of developing and maintaining social complexity within a framework of resource use and sustainability, focusing on the recursive relationship between humans and the environment.

Before it is possible to discuss the emergence and maintenance of social complexity, it is first necessary to have a clear definition of what is being discussed. Social complexity is generally agreed to be inequality based on factors other than age and sex, which seem to be near universal forms of human organization (Hayden 2001:232), and this is the definition I will use in this chapter. In addition to this very basic definition, a number of other characteristics have been identified as defining or relating to social complexity. The heritability of inequality is often considered an essential component of social complexity. Also, much writing on social hierarchy makes an important though not often explicit differentiation between the "real power" associated with leaders in highly organized complex societies and the strong influence wielded by leaders in less organized transegalitarian societies. This differentiation between power and influence seems to rest on the degree to which the decisions of the elite can be enforced against the will of the non-elite and often involves whether or not the elite has the means and right to use violence. It is my hope that this chapter will contextualize these aspects of social complexity and show that they, too, can be understood within the economic framework I construct.

THE ECONOMIC FOUNDATION OF INEQUALITY

Staying Egalitarian: A Complex Job

In the early days of social evolutionary theory, egalitarian bands were often referred to as “simple.” Although this designation was meant to indicate the bands' level of social organization, it was often misinterpreted to mean that the rules governing these societies were themselves simple. However, subsequent ethnographic research has shown that the rules governing egalitarian societies are in fact quite complex and that the egalitarian goal of individual autonomy for adult males forms a powerful ethos that is actively practiced and maintained (Boehm 1999; Cashdan 1980; Flanagan and Rayner 1988:2; Lee 1979; Woodburn 1982). The practices of maintaining egalitarianism are costly in terms of both time and resources, meaning that egalitarianism should not be seen as the “cheap option” in social organization, practiced primarily by groups whose environments will not support the surplus production necessary for social complexity. While particularly unproductive environments may encourage egalitarian social organization because its emphasis on sharing helps equalize access to sporadically-available resources, egalitarian social organization is also found in areas of resource abundance (Lee 1969), demonstrating that a society may choose to spend abundant material resources in the costly mechanisms of egalitarian social organization. Egalitarianism should be seen as an adaptive strategy in which the high cost of maintaining egalitarian social structures can be paid in investments of time where abundant resources are not available.

Before examining egalitarian social organization in more detail, it is important to locate egalitarian groups culturally. Anthropologists who study egalitarian groups have identified a cross-cultural egalitarian ethos that is an integral part of these groups as moral communities. This egalitarian ethos encourages humility, friendliness, and generosity and discourages bragging, drawing attention to oneself, and being seen as pushy. The autonomy of (at least) all adult males is prized and any threats to it are dealt with by the collective moral force of the community. In this way, egalitarian societies are “reverse hierarchies” in which the majority can dominate the potentially powerful and keep them in check (Boehm 1999).

Two particular components of the egalitarian ethos will come into play in my discussion of how social complexity can emerge in previously egalitarian societies. First is the moral condemnation of overt leadership. While discussion and persuasion are tolerated in egalitarian societies, actions seen as attempts to coerce or lead are considered threats to autonomy and are grounds for actions of moral aggression against the perpetrators. The second is the moral condemnation of the acquisition of wealth. The acquisition of too much wealth can in itself be seen as a threat to the egalitarian order because it is tantamount to bragging. Ethnographic study has observed that leveling mechanisms prevent successful hunters from using their success to gain excessive influence in egalitarian forager societies (Wiessner 1996). Additionally, skillful hunters often compensate for their success by having fewer possessions than less successful hunters, and leaders in egalitarian societies, whether their leadership is formal or informal, are often the poorest members of the group (Boehm 1999:70). Additionally, many egalitarian societies incorporate the periodic destruction or loss of personal property into ritual activities, tempering the possibility that individuals might be able to use wealth to unduly influence or coerce others.

I will now examine several ethnographic examples of successfully-maintained egalitarian social organization, paying particular attention to the relationship between ideologies and economic practices. Gerlach and Gerlach (1988), in an ethnographic study of the Digo of Kenya in the 1950s, found that traditional, matrilineal organization contrasted with the new patrilineal organization that became available with the increasing Islamicization of the Digo. When the British outlawed slavery in 1907, the resulting changes in land ownership and social organization caused the formerly hierarchized Digo to become an egalitarian group with a strong memory of having been a hierarchized group in the recent past. The memory of hierarchy encouraged the Digo to prize their egalitarian organization. Although women, children, and old men were considered to be dependent on the "greater wisdom" of adult men, everyone expected to be consulted in decision making and to be treated with respect. The senior men also were expected to possess a sense of duty to use their rights for the honor and benefit of the group. If the men abused their trust, other members of the group questioned their right to leadership by invoking competing rules of inheritance" (Gerlach and Gerlach 1988:118). The complex

and sometimes contradictory rules of Digo inheritance that arose from recognizing both matrilineal and patrilineal descent allowed the Digo a variety of valid but competing ways of interpreting the conflicts that often arose over property rights. The Digo's history of slavery, in which slave women had been classified as “sisters” in their masters' lineages, further complicated the identification of matrikin and patrikin. No systematic reconciliation of matrilineal and patrilineal organization was possible, and the irreconcilable nature of most conflicts promoted compromise. The very complexity and internal tensions of the rule system are what allowed Digo social organization to remain egalitarian in the face of attempts by the British to hierarchize it.

The complexity of Digo inheritance and conflict resolution had the economic effect of keeping property fairly evenly distributed within the community. The large number of individuals with some claim to a person's property at their death kept inheritance from leading to the accumulation of wealth. Also, conflicts taken to the council involved compensating everyone who participated in the proceedings, both members of the council and witnesses, and celebrating the successful resolution of the conflict by going to the local shop and drinking soda together. Thus, conflict itself, which often occurred over property rights, prevented wealth accumulation and reinforced values of equality and compromise.

Rayner's (1988) work on socialist political organizations in Great Britain in the 1960s and 70s provides another ethnographic example of the complexity of rules necessary for maintaining egalitarian social organization. Rayner studied about 40 Trotskyist and Maoist groups, focusing on the phenomenon of rapid schism that tended to characterize them. Only one group, the International Marxist Group (IMG), showed a pattern of stability and growth. The IMG “did not suffer from the crippling scale of schism, mass expulsion, and membership turnover that beset its chief rivals" (Rayner 1988:23). Rayner found that the success of the IMG rested upon the complexity of its rule system. The IMG had detailed rules for organizing meetings, disseminating information, and expressing and resolving dissent. These rules focused on maintaining each individual's or faction's equal access to the group's resources of money, time, and political process.

In another study of egalitarian groups, Rayner (1988) looked at two American

local interest groups dedicated to eliminating nuclear technology. These were the Clamshell and Abalone Alliances active in New Hampshire and California in the late 1970s and early 80s. Both groups practiced consensus decision making in which a single individual had the power to block any action from being taken. They also actively discouraged the rise of individual leaders, who were regarded with suspicion as a threat to the egalitarian organization. In order to maintain their goal of decision-making without leaders, the Alliances developed “highly elaborate structures that defined how, and under what circumstances, decisions were to be made” (Rayner 1988:34). In order to allow greater flexibility, however, the Alliances expected their smaller, geographically-based constituent groups to act independently when responses to more local problems were called for.

Rayner's two examples share two characteristics that contributed to their success and longevity as egalitarian groups. The first is that they developed rules that ensured equal access to the group's resources: time, money, and political process in the case of the IMG and time and political process in the case of the Clamshell and Abalone Alliances. The second is that they incorporated rather than forbade dissent and independent action. The IMG had rules for how dissent could be formally expressed, and the mechanisms by which dissent was expressed, including the circulation of pamphlets expressing the grounds for dissent, were supported by the IMG's collective resources. The Alliances insisted on consensus-based decision making, allowing individuals who dissented from the prevailing opinion to delay any action being taken until their concerns were addressed, and the Alliances encouraged rather than forbade the independent actions of their constituent groups. Incorporating rather than forbidding dissent and allowing independent action had the advantage of allowing both the IMG and the Alliances to maintain social structures that were both stable and egalitarian, but this form of organization carried high costs. In 1978, the IMG spent £8000 on a conference of only 1000 people (Rayner 1988:39). The cost of the Alliances' system was paid in time and effort: “any major decision thus took at least two weeks, usually more, and required hours of discussion involving any member willing to participate” (Rayner 1988:35).

Comparing the example of the Digo with Rayner's findings on socialist organizations supports the conclusion that complex rule systems and the incorporation of

dissent are essential for maintaining egalitarian social organization. Although the Digo's rule systems are somewhat different in that they were not invented *ex novo* as were the systems of Rayner's socialist and community action groups, they are similar in that the competing claims of matrilineal and patrilineal descent, both recognized as legitimate, created complicated, individually specific situations in which disagreement was recognized as valid and in which compromise was required.

Establishing Economic Alienation: The Birth of the Political Economy

The system that egalitarian societies like the Digo work so hard to maintain is equitable access to cultural goods. These goods may be material or non-material and include prestige, the decision-making process, and the primary resources necessary to produce or procure food, shelter, and tools. Equitable access does not necessarily mean strictly equal access: adults may have more access to prestige than the young or the old, men may have more access to the decision-making process than women, higher-ranked lineages may have more access to primary resources than lower-ranked lineages. However, no one is alienated from access to cultural goods.

The transition from an egalitarian society to a society with social complexity is marked by the increasing alienation of some members of society from cultural goods. In societies with social complexity, categories of cultural goods have become group-specific. All members of an egalitarian group may earn prestige and all have a place somewhere in a prestige spectrum; however, in some transegalitarian societies prestige has been transformed into status, an expression of recognized superiority to which not all members of society have access, no matter how personally capable they are. Similarly, rank, which organizes groups within society according to cosmological structures or metaphors and assigns them positions of greater and lesser importance, can be transformed into class, in which some members of society are excluded from the ranking system entirely (note: Fried's (1967) original conception of a 'rank' society more closely remembles the definition of class than the definition of rank used here). Finally, all members of egalitarian societies are involved in food procurement, production, and processing to some degree and are responsible for the disposition of the fruits of their

efforts, although culturally-enforced rules about sharing may mean that individuals do not have complete control of how their products are distributed. In more complex transegalitarian societies, however, there exists a group of people who have a right to some of the products of others without owing them economic benefits in return.

I consider this last, economic aspect of inequality to be the primary force in the creation and maintenance of social complexity. In economic terms, a society with social complexity is one in which one segment of the population has succeeded in alienating some other segment of the population from full economic rights held by the acknowledgement of the group. These may be rights to public goods or primary resources that all members of the group have access to, rights to specific resources held by a particular sub-group, lineage, family, or individual, or individuals' rights to the products of their own labor. The alienation of one segment of society from some or all of its economic rights is the foundation of the political economy. Without some amount of surpluses extracted from the non-elite population in a complex society, the privileged class – the elite – cannot engage in elite activities such as attracting followers, displaying wealth, organizing warfare, motivating labor toward monumental constructions, and conducting legitimating ceremonies. Unless the elite engages in elite activities, nothing sets them visibly apart from producers and they are unable to sustain their status as members of an elite class. Maintaining elite activities requires the control of surplus, which necessitates the economic alienation of a segment of society.

The development of socially stratified societies in environments capable of producing a subsistence surplus has been amply demonstrated, even for forager societies (Ames 1994; Arnold 1996a; Hayden 1998). The relationship between surplus production and social stratification can be explained partially by the obvious fact that a surplus is essential to support an elite whose position is founded on their ability to dispose of more goods than they can produce themselves. If a surplus cannot be produced, an elite cannot engage in elite activities. However, the ability to produce a surplus is not a sufficient cause of stratification (Carneiro 1970:733–734; Pearson 1957) nor is it the most important precondition of stratified societies; it is the ability to make that surplus reliable, primarily through storage, that actually removes or greatly lessens the penalty for defaulters in a sharing system. If a subsistence surplus cannot be stored, a stratified

society would be extremely unstable. The producing segment of society would have to resist the demands of the elite for only a short period of time before the elite would use up its resources and be powerless. To support a stable elite, resources must be able to be accumulated and stored for significant periods of time.

The ability of a group to produce a storable surplus does not automatically lead to the formation of social hierarchy, however (see Gould 1982) for an example of egalitarian groups with storage). As I demonstrated above, egalitarian social organization is costly. The time lost to egalitarian decision-making processes may cut into the time available for investing in food production or procurement. Group ceremonies may consume large amounts of resources, as may offerings and gifts associated with life crises such as initiation, marriage, or spiritual possession. Egalitarian organization is not simply the cheaper option, forced on groups by environments that cannot produce a surplus. Although the possibility of producing a storable subsistence surplus is a clear economic precondition for social complexity to develop, it does not explain the process by which economic alienation becomes ideologically justified and culturally acceptable in a formerly egalitarian group.

The accumulation of wealth by individuals is also not in and of itself responsible for the formation of social stratification. Leveling mechanisms, such as the destruction of personal wealth either periodically or at an individual's death, can quickly restore the economic balance (Nash 1966:78–79; Wiessner 1996). Even if an individual's wealth is not subject to destruction through leveling mechanisms, a member of an egalitarian society could become exponentially wealthier than his fellows without being able to alienate them from their rights to access the public goods and primary resources that allow the development of wealth. Again, although the accumulation of personal wealth is clearly linked to the formation of social complexity, whether as a partial cause or as a result of its formation (or quite possibly as part of a feedback loop in which it is both partial cause and result), wealth alone cannot alienate some members of a society from full economic rights (Hayden 2001:250). Wealth must be leveraged to control others' behavior before it can be used to create economic alienation, and this use of wealth is avoided and condemned by the egalitarian ethos.

Alienating a segment of society from some or all of its economic rights must

proceed by an acceptable path that can be justified within the egalitarian ethos or it is likely simply to be rejected and may be solved summarily by the killing (Durrenberger and Tannenbaum 1992:78) or banishment of the offender. Many egalitarian societies can access culturally-sanctioned mechanisms for getting rid of people who threaten the balance of power. Societies may also choose to rebel against leaders who attempt to control others' surpluses while avoiding their reciprocal obligations to the surplus-producers; for example, in the well-known example of the Kachin of highland Myanmar, leaders who tried to take advantage of their high position in the ranked lineage system without fulfilling their kinship obligations inspired rebellion and village fission (Leach 1970). Creating economic alienation must therefore occur within the pre-existing boundaries of socially acceptable behavior. It must be grounded in concepts of legitimate ownership and cannot be seen as threatening individual autonomy.

What constitutes legitimate ownership differs cross-culturally, but the main ideologies that legitimize ownership may be divided into 1) claims supported by cosmology, 2) claims supported by membership, 3) discovery/procurement/production, 4) gift/exchange/loan, and 5) inheritance. The legitimacy of ownership is maintained through cultural replication and affirmation of the ideologies by which resources are owned. Ideologies must be practiced publicly in order to maintain their cultural sanction and examples include ceremonies that retell origin myths in the case of claims supported by cosmology or the witnessing of how a deceased person's good are distributed in the case of inheritance. Frequently, many types of ownership claims are enacted simultaneously, as with requests for permission to use resource territories among the Yolngu of northeastern Arnhem Land:

> The granting of subsidiary rights in land and natural resources almost always involves negotiation. In negotiating, people bring to bear claims based on a range of factors including such things as kin ties, myth links, shared ritual obligations, affinal duties, and outstanding debts. They may assess all pertinent accounts in reaching a decision. (Williams 1982:151)

The public enactment of ownership is what allows the continuity of ownership ideologies, but it is also a forum for the manipulation of these ideologies. A manipulation of ownership ideology that takes place publicly without being successfully challenged

becomes available as a precedent for similar manipulations in the future.

The ideologies of legitimate ownership interact in complex ways and, in theory, no manipulation of ideologies of ownership may be necessary to create economic alienation in the absence of ideologies that enforce sharing. For example, if stochastic processes cause a family to lose all its primary resources in a society with no cultural obligation to support and resupply the destitute, members of the unlucky family may be forced to accept a position of economic alienation in order to survive (e.g. become slaves or emigrate to an area where, as foreigners, they have no claim to primary resources). However, such a situation is probably rare (but see Gould 1982 for the example of the Tolowa and Yurok Coast Indians). Most egalitarian groups recognize some cultural obligation to share resources, although the ethnographic record is rife with evidence for attempts to avoid sharing obligations (Peterson 1993; Sahlins 1972:125). Given that archaeological evidence indicates that human society was organized into egalitarian bands for the majority of its existence, it seems safe to assume that most economic alienation first occurred in the context of egalitarian ideologies that required creative manipulation before they could be used to legitimize unequal access to resources.

Table 1 lists the five main ideologies of legitimate ownership. For each of these ideologies, I list methods that 1) maintain economic and social equilibrium, 2) allow the accumulation of wealth and the beginnings of social disequilibrium, and 3) allow the creation of economic alienation and the creation of institutionalized social hierarchy. These “methods” include ideologies, ideologically-enforced practices, acts of individual agency, and natural stochastic processes. In general, a progression can be seen from the ideologies represented in the first row to the ideologies represented in the third row.

Table 1 shows that the steps between ideologies that support egalitarian economic access and ideologies that create economic alienation can be quite small. For egalitarian ideologies of food procurement to become ideologies of alienation, all that is required is a shift from an emphasis on sharing to an emphasis on private storage as the method of buffering against food shortage (Flannery 2002). This can easily occur over time in an environment in which surpluses can be produced and stored and food shortage is sporadic enough that food sharing does not need to be practiced regularly. Ideologies that are not

Table 1: Methods of maintaining, threatening, and destroying social equilibrium

Ideologies of legitimate ownership	**Claims supported by cosmology**	**Claims supported by membership**	**Discovery/ procurement/ production**	**Gift/ exchange/ loan**	**Inheritance**
Methods of maintaining economic and social equilibrium	* Cosmology assigns some access to resources to everyone, usually by lineage	* Everyone in society is a member of the group * Group membership cannot be revoked	* Discovered resources belong to the group * Procured resources (e.g. hunted game) must be shared with the community * The community has an obligation to support the destitute should stochastic processes destroy all their resources	* All gifts create an obligation on the receiver to return a similar or larger gift at some point * Collecting interest on loans is culturally prohibited	* Destruction of wealth periodically during life or at death * Property of the deceased is divided among entire group * Cultural rules dictate that property is divided evenly at death
Methods of wealth accumulation	* Continuing lineage through legitimate children who maintain claims to cosmologically legitimized ownership	* Membership cannot be revoked from original group members but foreigners who join the group do not have to be granted full member status	* Discovered resources belong to the discoverer with little or no obligation to share * Surpluses of procured or produced resources can be stored; obligations to share are specific and limited	* Powerful or influential people receive more gifts than others * People with a lot of stored wealth make loans that are repaid with interest * Talented traders are able to make exchanges/sales that are to their advantage	* Passing wealth to children/heirs rather than entire community * Personal choice is allowed to influence or determine how property is distributed after death
Methods of creating alienation from wealth	* Very immoral behavior by member of lineage invalidates cosmological legitimacy (the gods withdraw their support) * Conquest: conquered people must submit to the conqueror's cosmology, in which they have no place and therefore no legitimate ownership	* Group membership can be revoked, either through culturally acknowledged processes such as ostracism or through manipulation of membership ideology	* Stochastic processes result in some people losing all their products, including the means by which to get new products (e.g. seeds reserved for planting the next season are destroyed by mold); obligations to share are specific and limited	* Debtor cannot repay the debt, must accept alienation from primary resources as payment of debt (foreclosure, debt-slavery, etc)	* Only one child inherits, other children have no legitimate claim to wealth (primogeniture, ultimogeniture) * Personal choice determines how property is distributed after death; favoritism is allowed

practiced regularly and publicly lose their cultural affirmation and are more difficult to access should it become advantageous. This simple process can help account for the

strong correlation between environments that can produce storable surpluses and hierarchically-organized groups.

Inheritance is another form of ownership where the distance between egalitarian economic access and economic alienation is short. Only a small degree of personal choice in how a person's property is distributed after their death is necessary for the desire to keep property within the family to lead to inheritance systems that progressively alienate less successful families from the means to produce wealth. In extreme examples such as primogeniture, even healthy adult male members of the family may experience economic alienation due to inheritance practices. Like the correlation between storable surpluses and social complexity, the correlation between successful inheritance and social complexity has long been recognized, and the link between storable surpluses and inheritance is obvious. While the ability to inherit tools, weapons, clothing, housing, and other goods is both culturally and economically significant, it is the ability to inherit storable surpluses, the means to produce storable surpluses (land, seed crops, fishing weirs, etc), and wealth items that can be converted into surplus that is most likely to create a positive feedback loop. A recent series of studies (*Current Anthropology*, February 2010) strongly supports the important relationship among inheritance, storable surplus, and social complexity.

Using gifts, exchanges, and loans to create economic alienation is also fairly straightforward. Loans in particular are powerful tools in this sense. Although I argue that wealth accumulation in and of itself does not create social hierarchy, I do see the accumulation of wealth playing a significant role in the creation of economic alienation, and one method of using wealth to alienate others from full economic rights is through the offering of loans. When loans cannot be repaid according to the stipulated conditions, the defaulter may suffer consequences that alienate him or her from their rights to primary resources. They may enter into a relationship of obligation to their creditor, always owing a certain portion of their produce to the creditor until the loan is repaid (Bender 1978; 1985; Spielmann 1998). If the interest is high or the debtor's ability to produce is low, the relationship may become permanent. Under certain circumstances it may even be heritable, placing the debtor's children under similar obligation. Another possibility is that the creditor may simply demand the debtor's primary resources in

compensation for a loan on which the debtor has defaulted. Depriving the debtor of the means of producing wealth, for example land or livestock, may permanently alter the debtor's economic potential, placing him in a relationship of obligation to the creditor, who may allow him to use the resources he formerly owned in exchange for enough of the produce to live on.

Gifts given to those who cannot reasonably be expected to repay them may function in a similar way by creating a permanent state of obligation of the receiver to the giver. A perception of unsolicited gifts as rude and dominating is often found egalitarian societies (Peterson 1993:869), and a recognition of their potential social dangers is made explicit in the observation of an Eskimo informant: "With gifts you make slaves just as with whips you make dogs" (Freuchen 1961:154).

For the other two forms of legitimate ownership, ownership supported by cosmology and ownership supported by group membership, the process of going from ideologies of egalitarian economic access to economic alienation is less straightforward and requires more creative manipulation of the available egalitarian ideologies to succeed. Ownership claims based on cosmology are difficult to alienate, because origin myths and other legends are a cultural property usually accessible to everyone at least through passive knowledge and frequently through active participation in the retelling and reenacting of these myths and legends. If cultural goods are held through cosmological justification, it may be very difficult to deny a group member's right to them. The simplest way to create a segment of society that is alienated from these rights is to incorporate individuals into the group who do not share the group's origin and therefore do not have access to the rights guaranteed by the group's origin myths. This can occur through the incorporation of immigrants into the group, the taking of slaves from unrelated groups, and the conquering and subjugating of unrelated groups.

Finally, claims supported by group membership seem like they could be the most difficult to alienate. If simply being a member of the group is sufficient to justify an individual's claims to cultural goods, how can that right be taken away? Interestingly, ethnographic studies show that inflexible egalitarian ideologies of belonging can in fact be the easiest to manipulate in this manner. Rayner's work identifying the International Marxist Group (IMG) as the one socialist political group in 1960s and 70s Britain that

successfully avoided schism also examined some of its main rivals: the Workers' Revolutionary Party (WRP) and the International Socialists/Socialist Workers' Party (IS/SWP). In both the WRP and the IS/SWP, charismatic leaders established the rule that there were to be no factions within the group (Rayner 1988:30). On the surface, this rule is the definition of egalitarian: the entire group must work together, share values and goals, and exclude no one from anything. However, the reality of how this rule played out politically was different. Rayner found that:

> Demotion in a hierarchy or restriction of access to the public goods provided by an egalitarian group are not practical sanctions, because hierarchies are not recognized, and restriction violates the egalitarian ethic. Expulsion is the only credible penalty. So, when disputes in voluntary organizations cannot be resolved by resort to precedent or hierarchy, one faction will be tempted to accuse another of being outsiders or traitors who have, therefore, forfeited their rights of equal participation in the group. The very fact of organizing covert factions in groups where factions are forbidden...is grounds to justify this kind of expulsion." (1988:24)

Although egalitarian societies that experience the autochthonos formation of social hierarchy exist under different conditions than voluntary political groups practicing egalitarian organization while embedded within the larger, non-egalitarian workings of states, it is easy to see how the manipulation of ideology could function in the same manner in both cases. By affirming the importance – and uncompromising nature – of "belonging" to the group, a charismatic individual can redefine group membership so as to exclude former members. Once the status of full group membership has been revoked, full economic rights can be denied to the new class of non-members. Rayner notes that the socialist political organizations that adopt "no factions" ideologies "are especially prone to the problems of schism, for while a charismatic leader may resolve disputes in the short term, long-term rivals will accuse the leader of violating the group's egalitarian principles and split off, especially if exit costs are low..."

Again, although the differences between egalitarian forager bands and socialist political groups are obvious, the parallels are obvious as well. Although simple egalitarian ideologies enforcing strict equality may be easy to manipulate to create a segment of non-members within society, schism is an easy alternative to loss of full

economic rights when exit costs are low, and exit costs are indeed low in most forager groups, where there is little investment in food-procurement technologies that cannot simply be carried off or reproduced elsewhere, and where moving to a new area does not usually carry high opportunity costs. Schism only becomes unavailable as an alternative to economic alienation under a handful of circumstances: 1) when surrounding territories are so densely populated or thoroughly exploited that moving into them is likely to provoke a violent reaction from their inhabitants (cf. Carneiro 1981), 2) when surrounding territories cannot support human habitation and the cost of getting to habitable areas is prohibitively high, and 3) when significant investments have been made in non-moveable food procurement or production technologies. It is therefore not necessary to suppose that, for most of human existence, humans successfully practiced the complex and competing egalitarian ideologies that would have allowed the long-term perpetuation of the egalitarian system, as in the cases of the Digo and the IMG. It is only necessary to suppose that in most areas, schism and relocation remained available as an alternative to the loss of full economic rights.

It seems, then, that the key to the establishment of the political economy is a successful manipulation of egalitarian ideologies to create member and non-member statuses under circumstances in which the non-members cannot simply “vote with their feet” to reject their demotion and newly-limited economic rights. This observation goes a long way in reconciling many previous observations about the development of social hierarchy. Carneiro's (1978) hypothesis that social hierarchy is caused by environmental circumscription would be an example of the first condition under which mobility cannot be used to resist economic alienation: when surrounding territories are so densely populated or thoroughly exploited that moving into them is likely to provoke a violent reaction from their inhabitants. However, it has been demonstrated that absolute population pressure in a region is seldom the cause of violent conflicts among neighboring groups, and it seems likely that, although the impossibility of schism due to absolute population density and the resulting creation of member and non-member statuses is possible, it is not a situation that is likely to have obtained very often.

Carneiro's hypothesis can also be interpreted in a manner more likely to explain historical events of hierarchy formation. As Carneiro proposed his hypothesis, the

“environment” meant productive land measured in area and “circumscription” meant the occupation of this land to carrying capacity. However, the environment can and should be construed to include any investments in the land that raise its productivity and make it preferable to remain on that land in a demoted status rather than relocate. This is the third situation I identify as leading to economic alienation: when significant investments have been made in non-moveable food procurement or production technologies. The greater the amount of energy invested in creating the land's productivity, the higher the cost of relocation and the more difficult it is to avoid demoted status through schism. Circumscription, therefore, can be seen not simply as having no access to unused and uninhabited land, but having no access to improved land.

The importance of land improvements in the process of developing social hierarchy has been discussed in relation to agriculture. The development and intensification of agriculture has been proposed as a cause of the formation of social hierarchy. However, the uncomplicated correlation between population pressure, intensification of agriculture, and social hierarchy has been questioned on ethnographic, historical, and archaeological grounds. Håkansson observes that:

> While defensible resources and scarcity may very well have played a role in the emergence and maintenance of persistent economic inequality in the past, such conditions often occurred without general land scarcity. One example of this is the investment in land-esque capital in the form of durable landscape and soil modifications, for example, terracing and irrigation, which occur frequently in the historical record... (2010:2)

Although agriculture may be a key component in the development of economic inequality because it can provide the surpluses necessary to support a class that must control more than it produces, it isn't agriculture itself but the investment in non-moveable resources that prevents schism and allows the formation and enforcement of non-member statuses with limited economic rights. Relationships between investments in non-moveable resources, Håkansson's “land-esque capital,” and the existence of power hierarchies have been observed in Hawaii (Earle 1997; 2002) and on the Pacific Northwest coast (Ames 1994). Similarly, the adoption of agricultural and food-production practices that required long-term investments, such as Mediterranean

polyculture, have been suggested as allowing social hierarchy to develop in the European Bronze Age (Gilman 1981).

Reconsidered in terms of the role played by non-moveable resources, Wittfogel's hydraulic theory for the formation of states (1957; see Adams 1966 for a similar approach), though much discredited (Earle 1978; Green 1980; Kirch 1977), shows insight: while social hierarchies did not evolve *in order* to manage irrigation systems, they may have arisen because the reliance on irrigation systems made it impossible for demoted non-members to escape their demotion. Finally, a correlation between my second circumstance that allows the creation of economic alienation, when surrounding territories cannot support human habitation and the cost of getting to habitable areas is prohibitively high, has also been observed. Hierarchical societies have tended to develop on islands, such as the Hawaiian islands, and in strongly bounded ecological zones, such as the Nile valley and the valleys of coastal Peru (Willey 1953).

The situation I have presented thus far is a binary system: individuals are members or non-members, have full economic rights or limited economic rights. In such a situation, it is hard to imagine any individual accepting limited economic rights if mobility is at all an option. I have intentionally presented a binary situation for its explicatory value, but we should imagine the situation occurring along a sliding scale. Schism, while possible as long as mobility is not restricted, always carries some economic cost in terms of time lost to the move, loss of belongings that cannot be moved, loss of unharvested crops in a horticultural or agricultural society, etc. It also carries emotional and cultural costs – leaving behind loved ones, a known place in a familiar society, and connections to culturally valued places – that are likely to be as if not more prohibitive than the economic costs. In some situations, particularly in a situation of loss of full economic rights through defaulting on a loan or being in obligation to another through the inability to return a gift, schism may be seen as unwarranted because the loss of full economic rights is considered fair or is legally enforceable (e.g. Hoskins 1993:176). Additionally, some losses of full economic rights may appear temporary, with the alienated member of the group believing that they will repair the damage and regain full economic rights in the future. Finally, it is possible for outsiders to want to join the group, voluntarily accepting restricted economic rights in return for the perceived

advantages of belonging to the group.

Gerald Mars's study of Israeli kibbutzim (1988) shows how hierarchy can develop and exist within a society maintaining explicitly egalitarian ideologies of social organization. The stated political goal of the kibbutzim studied by Mars was to end all exploitation of labor by institutionalizing direct democracy, creating a General Assembly of the whole kibbutz membership, and rotating all managerial jobs with term limits of three to five years. Over time, the term limits of the managerial jobs increased, the managerial jobs rotated among a restricted number of qualified and experienced kibbutzniks, and the holders of managerial jobs had access to special privileges like expense accounts. These managers developed multiple loyalties with their political and business partners outside the kibbutz, and were able to restrict the information and choices available to the General Assembly, whose power declined as its members lacked the specialist knowledge necessary to make complex decisions.

In addition to developing a managerial elite, the kibbutzim developed a demoted class in the form of foreign students who lived and worked in the kibbutzim in exchange for food, accommodation, pocket money, and the experience of living abroad. These students performed manual labor in factories and farms, were housed in a separate compound, and were not allowed to vote in the General Assembly. Mars observes “[The students'] relative lack of power over the allocation of resources and the making of policy, their lower level of prestige in the eyes of the core members, and their lower level of economic reward are certainly indicative of a proletariat. But it is their role as labourers who lack capital that crucially defines them as such” (1988:107).

In spite of the effective hierarchy being practiced in the kibbutzim, neither the kibbutzniks themselves nor many of the scholars who have studied them recognized or acknowledged its existence (Mars 1988:101). The less-than-equal treatment of the foreign students in the kibbutzim and its implications for the egalitarianism of the group were mediated by assigning the students a non-member status. Because the students were not members, they could be assigned unpleasant jobs, be recompensed less than members for their work, and be denied decision-making power. The kibbutzim's claim to end all exploitation of labor remained valid only through a creative manipulation of the definition of a laborer, effectively a question of who counted as a person. The students'

non-member status meant they did not count as “real people:” they could be exploited, and their alienation from full economic rights was not seen to violate the egalitarian ideology.

Mars's study of the kibbutzim is interesting both as an example of how hierarchy can develop within a group maintaining explicitly egalitarian ideologies, but also as an example of a hierarchy that is accepted and seen as advantageous by all its participants. Not only do the foreign students who are given restricted economic rights not schism from the group, they seek out the opportunity to join the group as exploited non-members for the perceived benefits of the experience. This might not be the case if the students expected to spend their entire lives as exploited non-members of the kibbutzim; however, it serves to show that schism, even when possible, may not be practiced if the perceived benefits of staying are high enough.

We should thus imagine two interacting, sliding scales along which economic alienation and social complexity may develop. The first is the scale along which mobility is an available form of resistance to economic alienation. Generally speaking, mobility is highly available to non-sedentary foragers, available to simple horticulturalists and agriculturalists, and not very available to any group that has made significant investments in non-moveable resources. These economic practices must then be considered in conjunction with factors like geographical location and population density: simple horticulturalists living on an island may experience mobility that is equally as restricted as that of mainland agriculturalists who have invested in terracing.

The second sliding scale is the degree of economic alienation that demoted members face, which must necessarily be considered culturally contingent (e.g. total alienation such as the loss of all capital through defaulting on a loan may still not be cause for schism if it is considered fair). The interaction of these two scales serves as a predictor of the level of social complexity that can develop among particular groups. Even small amounts of economic alienation may be avoided by mobile foragers, some loss of economic rights or unequal economic obligations may be accepted by simple agriculturalists, and high levels of economic alienation may be forced on demoted group members in geographically restrictive locations or where investments in non-moveable resources are high.

MANAGING THE POLITICAL ECONOMY

Growing the Political Economy

The initial creation of economic alienation, resulting in an elite with some right to the production of the non-elite, does not guarantee the continuation of that elite. Incipient elites are unstable and subject to resistance (Brumfiel 1992). Once inequalities and new leadership structures exist, rulers and ruling lineages must strategize to define and retain their power. Beck (2003; 2006) has identified two general processes for power consolidation in transegalitarian societies; again, mobility is a key issue. In areas where mobility is restricted, such as geographically circumscribed regions like islands or areas where significant investments have been made in intensive food production, power consolidation is more likely to proceed by coercive expansion. However, in areas where subject populations can use mobility to ally themselves with more advantageous rulers or escape the demands of rulers altogether, power consolidation proceeds by persuasive aggregation.

Beck's model is based on circumscription defined by the mobility of the producing segment in the society: if it is not geographically impossible or economically disadvantageous to move, producers will employ mobility as a form of resistance to unpleasant elites, forcing elites to use persuasive rather than violent means for increasing their group's size and, by extension, the productive base they can access and manipulate. However, the producers are not the only group that may experience circumscription in a society with developing or established hierarchy. Elites, whose economic goals are not the same as those of producers, may view a particular economic situation differently. For example, producers do not have a strong incentive to produce more surplus than is required by their own needs and the demands of their managing elite. Elites, however, are caught in a self-reinforcing economic system that requires the constant increase of the surplus they are able to control (Earle 2002:94). If producers can meet their surplus production needs but elites are unable to increase the resources at their command, elites may experience circumscription where producers do not. If such a situation occurs where

producer mobility is not restricted by geography or by heavy investment in land improvements, elites are caught in a difficult situation. They cannot raise demands against their own group without risking losing followers through the exercise of mobility, but they must increase their resource base in order to maintain their position as elites. In this predicament, elites may resort to violence against neighboring groups to procure more resources, often in the form of slave- or livestock-raiding, but possibly in the form of conquest if the mobility of neighboring groups is restricted.

Given the different economic goals of producers and elites, producers would be considered circumscribed when either geographical conditions or investment in non-moveable resources make mobility an unavailable form of resistance to elite rule. Elites would be considered circumscribed when available strategies and technologies do not allow them to continue to increase the resources at their disposal on the land that is currently under their control. We can now produce a clearer picture of the different strategies elites may employ to grow their political economies by expanding Beck's model and considering producer circumscription, defined by available mobility, and elite circumscription, defined by the potential to increase available surplus within the currently-held territory, as separate factors. Table 2 shows the likely strategies that will be pursued under each set of circumstances.

As is frequently the case, more than one of the above strategies may be pursued simultaneously by an elite. A circumscribed elite may pursue the violent coercion of its producers, but it may also seek to violently exploit neighboring groups as well. Violent coercion of distant neighbors may also form part of an elite's strategy of persuasive aggregation, with the fruits of the violent raids being used to supplement the locally-produced surpluses the elite is able to distribute. In large, geographically diverse complex societies, all of the above strategies may be pursued simultaneously in different regions or among different classes of society. In sum, incipient elites must balance the freedom or limitation experienced by their producers with the productive capacity of their geographical locations to develop a strategy that will increase their available surplus without destabilizing their authority.

Table 2: Elite strategies in response to different combinations of elite and producer circumscription

	Producers Circumscribed	**Producers Not Circumscribed**
Elites Circumscribed	**Violent coercion**. Elites may raise demands on the producers within their group with the threat of violent coercion forcing producers to invest increasing amounts of labor in decreasingly productive forms of intensification. Elites may also attempt to conquer neighboring groups whose producers are also circumscribed.	**Violent exploitation of neighboring groups**. In this situation, elites cannot try to increase production by violent coercion – unhappy producers will defect. Elites must continue a rewards-based system for their own people and violent aggression against outsiders, possibly with the goal of creating a slave class that can be more efficiently exploited.
Elites Not Circumscribed	**Intensification**. Elites will invest in technologies of intensification to get the most out of their current territory without risking the losses that occur in violent conflict. Producers cannot evade increased demands on labor/production.	**Persuasive aggregation**. Elites want to convince followers to give them support and intensify production. Rewards must be offered both to retain followers within the group and attract followers from neighboring groups.

The Role of Innovation

Whatever strategy elites pursue in their attempts to grow the amount of resources at their disposal, enough growth will eventually tax the productive power of the strategy, leading to diminishing returns and a supply crisis for the elites. Such a crisis can destabilize and overturn an elite, leading to a decrease in social complexity, or it can be a catalyst for economic innovation. Boserup (1965) has demonstrated the power of population pressure to lead to innovations in agricultural strategies (see also Cohen 1977; see Cowgill 1975 for a critique of Boserup's model). These innovations may or may not be known prior to the experience of population pressure that encourages their implementation, but it is the need for more food rather than the innovations themselves that cause societies to implement new production strategies.

The needs of the elite for more surplus can act as a catalyst for innovation similar to that of population pressure. Although the need for more surplus for elite consumption clearly represents a different social problem than population pressure and one that would have been experienced differently by the members of a society, the economic problem, the need for more production, is the same. We should therefore expect to see innovation occurring in political economies under conditions when the ability of the economy to produce additional surplus is stressed. When it is the elites and not the producers who are

adversely affected by the lack of surplus, we should expect the innovation to be elite-led and occur in ways that elites can encourage or control.

There are two general ways in which the surplus-producing power of an economy can be stressed. The first is that the productive capacity of the economy itself can be insufficient. The second is that the geographical extent of the economy can become too great for the transportation of food surpluses to be practical. D'Altroy and Earle's (1985) division of the methods of financing social complexity into staple finance and wealth finance is a recognition of how elites may solve this second problem. Staple finance, the elite's reliance on surpluses of staple foods to finance their activities, places inherent limitations on the growth of political economies. The transportation and storage of bulky staple crops imposes high costs that may become impractical as a political economy becomes larger. When the transportation and storage costs of staple finance become too high, a transition to wealth finance can remove the limitations on growth (Earle 2002:148–149). By concentrating a high social value into physically small objects, the same level of social value represented by a prohibitively large amount of staple crops can be shipped easily as wealth items.

The innovation of wealth finance does not have to be a response to the increasing geographical extent of the political economy, however. A transition to wealth finance may also be a response to resource stress. When the productive capacity of a society's resource base plateaus and it is no longer able to provide increasing surpluses, the introduction of wealth, whose social value in the political economy is frequently greater than the cost of procuring or producing it, is the ideal solution. The introduction of wealth allows the elite to continue increasing displays of power and rewards to loyal followers in spite of diminishing returns in production of staple crops.

The introduction of wealth has numerous advantages as an innovation for combatting diminishing returns in staple crop production. The production of wealth seldom competes with the production of staple crops for land or supplies because the resources used to produce the two frequently have little overlap. Wealth items are generally subject to less frequent and slower decay than staple crops, allowing the storage of large amounts of social value in less space and for longer periods of time than would be possible with staple crops. Unlike the production of staple crops, the production or

procurement of wealth items may be considered an appropriate and even admirable elite activity, with the result that the acquisition of wealth need not take non-elite labor away from the production of staple crops. Finally, wealth can create value by having the social value of the wealth objects be incommensurate with the cost in staple production required to make or acquire them. Attached specialists are one example of how wealth items preserve resources. For the cost of feeding and housing the specialists, the elite can control their finished products, which are generally worth more than the cost in staple products of maintaining the specialists. In sum, the innovation of wealth in a political economy has the effect of creating more social value from a given set of resources than would be possible from staple production alone.

The introduction or increased use of wealth in a political economy is not the only form of innovation that can combat diminishing returns in staple crop production. Innovations in agricultural strategies of the kind that Boserup (1965) describes are also a possibility. Boserup's division of agricultural strategies into forest fallow, bush fallow, short fallow, annual cropping, and multi-cropping provides a framework for examining how agricultural innovations may have operated under the conditions that obtained in societies with incipient and growing social complexity. This division represents a scale of extensive to intensive agricultural strategies, with forest fallow being the most extensive and multi-cropping the most intensive. One of Boserup's key observations about this division is that absolute productivity per land area increases as agricultural strategies become more intensive; however, productivity per man-hour of labor decreases (see also Cohen 1977). Cultivators must work longer hours to achieve the increased productivity of more intensive agricultural strategies; this provides a strong disincentive for cultivators to transition to more intensive agricultural practices unless pushed to do so.

The impetus to transition to more intensive forms of agriculture can be provided internally by population pressure; however, the experience of colonial powers among indigenous cultivators shows that this impetus is very difficult for an external force to impose (Boserup 1965). Historical attempts to encourage indigenous cultivators to adopt intensive agriculture for the sake of increasing output and achieving greater economic success in a market system have frequently been met with resistance even when knowledge and equipment were provided (Boserup 1965:65–69).

We must conclude that modest increases in wealth are not reliably considered sufficient compensation for disproportionate amounts of additional labor, and that people in societies with developing complexity would also have resisted external pressure to transition to more intensive agricultural strategies. In these societies, that external pressure would have come from elites trying to extract more labor from producers to increase the surpluses at the elites' disposal. Considered in light of the conditions outlined in Table 2, pressuring producers to use more intensive agricultural practices is only a viable elite strategy in situations where the producers are circumscribed. Areas where population pressure had already forced egalitarian societies to invest in intensive forms of agriculture would be extremely susceptible to the rapid development and increase of social complexity, as would societies with strong population growth and incipient hierarchies. Once the transition to more intensive agriculture is made, elites can take advantage of the producer circumscription it causes to leverage more production and also, if technological advances allow it, subsequent transitions to even more intensive agricultural systems.

There is an alternative method for moving to more intensive agricultural production without producer circumscription, and that is the creation of a class of society with no economic rights whatsoever: slaves. In the terms of this discussion, slaves are those who have been completely alienated from all economic rights. They may be labeled as slaves by their own society or they may not be recognized as slaves but be functionally equivalent because they have no economic rights. Although it is not my purpose to address economic relationships within the household, it is worth noting that in some societies that are fairly egalitarian or have only low levels of social complexity judged by the standard of adult males, women may be *de facto* slaves (Boserup 1965:73–75).

It is likely that in many societies with developing social complexity, slaves were acquired through raiding, as is seen ethnographically (Leach 1970:161). It may be possible for an incipient elite to get the producers in their society to accept some level of economic alienation, but not a high level if mobility remains too much of an option for resistance. Under these circumstances, the elite must create a class of society that can be pressured to do the extra work of more intensive agriculture without fear that they will cause their producers to abandon them (cf. Carneiro 1981:65). Raiding for slaves solves

this problem by introducing a class of people with no ties to the group's cosmology or family structures and therefore no access to legitimate claims of ownership of the group's resources. These people can be exploited with the approval of both the elite and the producers and, in cases where producers themselves may come to own slaves, the incentive to prevent slaves running away and thus avoid the extra labor that would accompany their loss is spread from being the responsibility of the elite alone to being the responsibility of all members of the community who still retain some economic rights. Slaves who attempt to use mobility to resist their disenfranchisement are unlikely to meet with help from anyone other than fellow slaves. The punishment for such defectors if captured is also likely to be much higher than the producers would accept for themselves.

The three main innovations that can help expand an economy are therefore: the creation of social value through the introduction of wealth, the adoption of more intensive agricultural strategies, and the creation of a completely disenfranchised class of slaves whose labor can be more efficiently exploited than the labor of producers and whose cooperation is policed by both the elite and the producers.

SUSTAINING THE POLITICAL ECONOMY

From the elite perspective, the life of a political economy can thus be viewed as a series of expansions and crises. The economy expands as far as the methods of production, level of circumscription of the producers, and costs of transportation of goods will allow, and then the elite find themselves becoming circumscribed, unable to continue increasing the surplus at their disposal with the methods being used. At this crisis point, the elite must introduce some kind of innovation that increases the amount of social value the economy can produce or face questioning and weakening of their authority and the possible collapse of their elite status.

Resource Depletion

The preceding discussion highlights the fact that from the elite perspective there is no such state as equilibrium in complex societies. While producers may experience the

continuity of leadership as equilibrium, elites must constantly increase the social value that they control in order to stay in power. The ability to impress is essentially comparative. Even in the absence of other elites offering direct comparisons, elites who must impress to stay in power are constantly competing with their own past performance. Even consistency in the amount of social value that elites wield can only be tolerated for a certain perod of time before it is experienced as decline, a decrease in the ability to impress. A decrease in the ability to impress invites resistance, whether from lesser figures in elite lineages who would seek to seize power or directly from producers who may choose to resist elite demands or join other groups.

The obvious problem posed by this model is the question of whether any complex society can continue to increase the amount of social value in its economy indefinitely, as is theoretically necessary if the society is to remain complex. Many forms of resource use eventually result in resource depletion, whether the resources are by nature non-renewable, as mineral resources are, or whether they are renewable resources that are used up faster than they can replenish themselves.

Agricultural production is one area in which elites may deplete their resources. Each type of agriculture identified by Boserup has a threshold of productivity: only a certain percentage of the available land can be cultivated under each particular system. More than that, and the productive capacity of the land cannot recover sufficiently between crops, with the result that overall output may increase briefly as more land is brought under cultivation, but it then declines rapidly as the land is exhausted. Switching to a system of more intensive agriculture that includes measures to preserve the productive capacity of the land (i.e. use of fertilizer, crop rotation, etc.) can increase surplus more effectively. The greater productivity of the land is based on technological change rather than overuse, and the increasing levels of surplus produced can be maintained up until the point where all the land that can be cultivated sustainably under that system is being cultivated.

Switching to a more intensive agricultural system is clearly the more desirable method for elites to increase the surpluses at their disposal because the levels of increased production can be sustained, at least for a much longer time than can be achieved by overusing an extensive system of agriculture. However, once again we run into the

problem of producer mobility. Intensive agriculture requires longer hours and harder labor than extensive agriculture, and it would be difficult to force producers to practice a more intensive agricultural system if they were not circumscribed and could choose to resist the demands of the elite by moving away. Sustaining a political economy based on the surplus production of extensive agriculture may be impossible in areas without a strong component of geographical circumscription. Extensive agricultural systems such as forest fallow require low investment in improving the land and can easily be moved. Without geographical circumscription, elites whose producers practiced extensive agriculture would be unable to force a change to more intensive agriculture and could only expand the use of extensive agriculture, leading to overuse of the land and the destruction of the resource base on which their power was built.

The introduction of wealth items into a political economy is one innovation that may help elites maintain power when they cannot force a switch to more intensive agriculture. Wealth items are frequently produced using resources that do not overlap, or overlap only a little, with the resources used to produce agricultural surplus, providing a source of additional social value that can be increased without triggering the widespread environmental depletion caused by overusing an extensive system of agriculture. Because wealth items generally have a social value that is greater than the social value of the resources used to create them, they are a useful innovation for addressing crises in the political economy and extending the sustainability of the system.

The production of wealth items may also be impossible to increase indefinitely, however. The over-exploitation of any natural resource may lead to its depletion: birds with valuable plumage may be over-hunted, mollusks with prized shells may be overfished, and metal ores may be used up or the timber necessary to smelt them can be harvested faster than it can regrow. The depletion of the resources used to make wealth items leads to the same problem as the depletion of the resources used to support agricultural production: a decrease in output and a consequent plateau in the social value that can be controlled by the elite, with the attendant instability caused by the failure of the elite to legitimate their power by increasing and displaying their surplus and wealth.

An opposite but related problem that may also occur with the over-production of wealth items is the problem of abundance. Rarity is part of what makes wealth items

valuable. If they prove too easy to produce or procure and too many are introduced into a political economy, they may decrease in social value and fail to provide the constant increase required by strategizing elites.

Perception and the Creation of Value

It appears, then, that the long-term success of social complexity is dependent upon either 1) indefinitely sustained innovation that can add social value to the political economy without destroying the resource base or 2) a source of wealth that can be intensified indefinitely without destroying the resource base or devaluing the wealth. The first case is certainly rare and probably possible only in the short term. Even the impressive rate of innovation and increased social value achieved in the centuries following the industrial revolution is perceived by many to be reaching a crisis. The second alternative appears impossible and probably is impossible in a strictly material system. However, humans are not strictly material. Once humans have obtained the food, shelter, and tools necessary for subsistence and survival, perception rapidly becomes the dominant factor determining how much social value anything actually has, whether that something is a wealth item or a subsistence surplus. The relative social value of various items in the political economy can also be manipulated through perception; for example, a wealth object that is simply rare may increase in value if it can be styled as an object that only a chief can own.

Perception also adds a source of social value to the economy that I have so far left mostly undiscussed, which is behavior. Particular styles of walking and talking, exclusive rights to hunt specific animals, the right to perform rituals and have ritual knowledge, and many other forms of elite behavior have been observed as sources of social value in transegalitarian and complex societies. For example, the rights to do particular mask dances among the Nuxalk (Boas and Codere 1966; Holm 1983; Seip 1999) are specific to the chiefs who earn them, and collecting the rights to many mask dances is seen as prestigious. Although resources may be required to create physical manifestations of perceptions, innovations in perception do not directly consume resources. We should then expect to see innovations in perception playing a particularly important role in political

economies when they are in crisis.

The importance of innovations in perception for increasing the social value in a political economy has been widely discussed. Residential and burial segregation are both innovations in perception that create social value but do not necessarily use any more resources after they have been instituted than were used before they were instituted. Although more resources often are used in elite houses and burials than are used in those of producers, the simple fact of creating spaces to which producers do not have equal access is sufficient to add social value. The co-opting of ceremonial roles by the elite is another important innovation; elite ceremonies do not necessarily require more resources than do ceremonies in which all members of the community participate equally, but the social value of participating in these ceremonies increases.

Perceived social values are common innovations that appear to a greater or lesser degree in almost all complex societies. However, they are not long-term solutions to the problem of diminishing surpluses. In fact, they are likely to be part of the cause of diminishing surpluses. Innovations in perception such as residential and burial segregation are often some of the first archaeologically visible signs that a society has developed complexity. These innovations are instituted early in the development of social complexity, probably for economic reasons. Emergent elites have only a tenuous ability to extract surplus from producers and therefore not a lot of resources with which to reward supporters, hold feasts, fund monumental building projects, or engage in other activities that would legitimate their elite status. Under these circumstances, the social value added to the economy by creating an elite identity through spatial segregation or the co-opting of ceremonial duties may be extremely important to legitimating and maintaining the unstable new authority.

Once established, residential and burial segregation and greater control over religious practice may drive the need for more surplus as mere segregation and religious responsibility become familiar and larger houses, richer burials, and more impressive religious paraphernalia are required for elites to maintain their status. An innovation in perception can solve a crisis in the political economy, but it may also lead to future crises. If an innovation in perception is to remain sustainable in the long term, it must be able to increase social value without requiring an increasing input of material resources.

Inexhaustible Resources

No material source of social value can be intensified indefinitely and many sources of social value that rely on perception have a material component, tying them to the problems inherent in intensifying the use of material resources. There are, however, two sources of perceived social value that are inexhaustible and that most societies can incorporate into their political economy. These resources are distance and time. Under pre-modern conditions of travel and information transfer, distance may be considered infinite. No matter how effective a pre-modern society is at traveling, there are always other societies at the margins of their experience that can be considered exotic. The exact nature of this exoticism may vary: the distant foreigners can be considered dangerous, barbarian, subhuman, harmlessly strange, more advanced, benevolent, possessors of secret knowledge, or even superhuman. However the exotic identity is constructed, objects associated with exotic peoples gain social value by taking on their exoticism. The less familiar the object and the people it comes from, the higher its social value is likely to be.

Introducing exotic objects into a political economy is a way of adding social value that, in a pre-modern context, can potentially be intensified indefinitely. Although the procurement of exotic objects is difficult, the difficultly lies in the skill in traveling – and possibly in diplomacy – that is required to obtain them, and less in large material costs, though the costs of undertaking long voyages are not insignificant. While wealth items may be required in exchange for the exotic goods, the social value of the exotic goods is likely to be higher than that of the locally-produced wealth items. For the cost of a voyage, exotic wealth can be obtained or locally-produced wealth can be exchanged for exotic wealth, creating greater social value than could be levied from the local material resources alone. If too many exotic goods enter a political economy and they begin to lose their social value, there is always another society, farther away, that is a potential source of fresh exotic wealth.

Time as a resource works in a similar manner. Although there is no way to intensify the production of time, there is also no way to stop it from accumulating,

making it a reliable and inexhaustible resource. The passage of time creates temporal distance from the present which has social value in much the same way that geographical distance does. The past is often conceived of as heroic, mythic, or semi-divine, making the ability to link to it a powerful source of social value (Bradley 2002; van Dyke and Alcock 2003). Even the more recent past is associated with remembered great deeds and impressive persons. Harnessing the social value of the past gives elites access to a constantly increasing supply.

Various ways of harnessing the past have been observed. Remembering lineages is one common way. In the chiefdoms of Hawai'i, only chiefs were allowed to have and remember lineages, cutting producers off entirely from this source of social value. Another way of harnessing the past is by attaching it to specific objects. Objects can serve as excellent physical manifestations of the past. They frequently show wear or develop patinas, making their age obvious and undeniable. The whale teeth traditionally used as valuables on the island of Fiji were considered more valuable based on the high degree of polish that they developed over time (Thomas 1991:67). Accumulations of objects created over time can reference important repeated actions and the prestige of having participated in them, such as accumulations of cattle horns and pig skulls in the Kodi region of Indonesia (Hoskins 1993:202–220). Valuables can also be given object histories which enhance their value (Appadurai 1986; Hoskins 1998). The creation of "storied wealth" gives elites access to a source of social value that can be increased indefinitely without depleting resources. After the initial manufacture of a storied wealth item, all that is necessary for the item to increase in value is for it to remain unbroken and its stories to be remembered. As long as the belief system that values the storied wealth remains active, storied wealth also has the advantage of being nearly impossible to devalue. Social value increases with time, but the chance of loss or breakage also increases with time: it is very unlikely that a large enough number of storied wealth items will survive to be very old for these items to become so numerous as to lose their value.

One familiar ethnographic example of the use of storied objects as the center of political economy is the Kula valuables of the Trobriand Islanders (Gosden and Marshall 1999:170; Malinowski 1932). For the Trobriand Islanders who live on extremely resource-impoverished islands, both in terms of staple production and wealth production,

Kula valuables serve as an important source of social value that can be increased without increased investment of natural resources. Kula valuables require a small initial investment of natural resources for their manufacture and then gain in value independent of further investment of natural resources, through their growing histories and age and sometimes through further investment of time in improving and polishing. The cost of a trade voyage to acquire a less important Kula valuable is the same as the cost of a voyage to acquire a more important valuable (barring some greater cost in the larger number of initiatory gifts necessary to encourage the other chief to part with the more important valuable), but the wealth acquired has greater social value. By incorporating object history into the social value of Kula valuables, the Trobriand Islanders have created a technology that allows for an indefinite increase in value at a very small increase in resource use or depletion.

CONCLUSIONS

This chapter views the establishment, growth, and maintenance of social complexity as governed by three primary factors: the mobility of the producer population, the sustainability of the production system under conditions of intensification, and the use of technological innovations and innovations in perception to increase the available social value in a political economy. Mobility plays an important role in countering the development of social complexity. Where mobility is highly available due to favorable geography, lack of population pressure, or subsistence practices that can easily be relocated, it will be difficult to make producers accept a high degree of economic alienation. Any social complexity that develops where mobility is available as a form of resistance will have to be based on persuasion and is likely to be fluid and unstable, as incipient elites compete among themselves to attract supporters and small mistakes can result in rapid losses of power. Only the creation of a totally disenfranchised slave class can help stabilize power in situations of available mobility.

However, there are a variety of conditions under which mobility is not highly available. This may occur because a society is located in a geographical area that does not favor mobility, such as on an island, in a mountain valley, or in a desert oasis. It may

occur because population growth has forced a society to adopt intensive forms of agriculture or food production that are difficult to relocate. It may occur because subsistence resources are concentrated in a specific location or because a marginal subsistence environment has forced a society to invest in "land-esque capital" such as terraces or irrigation systems. Although a number of factors can restrict mobility, the politico-economic outcome of restricted mobility is the same: demoted segments of society can be forced to accept greater inequality. This includes more restricted economic rights, the increases of labor that accompany more intensive agricultural systems, and the use of violence by the elite to enforce their authority. This model of the development of social complexity reconciles a number of previous hypotheses such as those posed by Wittfogel and Carneiro, which clearly have some explanatory power but which have been found inadequate to explain the archaeological record.

After the initial creation of economic alienation, elites must employ diverse strategies to consolidate and reinforce their elite status and their authority over producers. These strategies must be chosen carefully based on the elite's level of circumscription and that of the producers they are trying to control. Inevitably, the goal of the elite is to create and control as much surplus as possible, whether this surplus is a subsistence surplus that is stored as a subsistence surplus, a subsistence surplus that is stored as wealth items, or a surplus production of the wealth items themselves. Without ever-increasing surplus, elites are unlikely to be able to maintain a level of elite activity sufficient to maintain their elite status, and their authority will be destabilized and lost. Conversely, however, incipient elites must choose their strategies carefully so as not to put a higher degree of pressure on the producers than the producers' level of mobility encourages them to tolerate. If elites are not careful, they are likely to make excessive demands, destabilize themselves, and lose their new authority.

Maintaining the constant increase in surplus that a political economy requires once it has been established can lead to a series of crises as diminishing returns in production force elites to innovate ways to add social value to their economic systems. In a situation where producers are not circumscribed, this can lead to new strategies such as raids against neighboring groups, the creation of a slave class that can be forced to do work that the producers will not tolerate, and innovations in perception that solidify and

emphasize elite identity. In a situation where producers are circumscribed, innovations may include the more intensive exploitation of the existing agricultural system despite diminishing returns (such as bringing marginally productive land under cultivation) or a transition to a more intensive agricultural system (such as switching from bush fallow to multi-cropping).

The introduction of wealth items is also an effective method of adding social value to a political economy, and is particularly useful when the geographical extent of a complex society becomes large enough to make surplus finance unworkable (Earle 2002). The introduction of wealth items is also useful as a method of creating value, because the surplus production or cost to surplus production required to make or acquire wealth items may have a lower social value than the wealth items themselves. The introduction of wealth items can be expected whenever elites are experiencing circumscription, regardless of the level of circumscription of the producers. The production of wealth items cannot be increased indefinitely without either depleting the resource base or devaluing the wealth item, however, and elites in areas that are either particularly rich or particularly poor in the resources needed to produce local wealth may draw on the ever-present resources of time and distance to introduce "storied" wealth or exotic wealth into the political economy.

The picture of social complexity in transegalitarian and complex societies that emerges from my economic analysis is that of an unstable system that must constantly be reconsidered and adapted in order to succeed. Errors of judgment on the part of the strategizing elite are likely to lead to instability, with decreases in complexity or shifts in power a frequent outcome. Setting this picture in an environmental frame adds a level of precariousness. Many environments are potentially fragile and cannot sustain the intensive exploitation of key resources or the intensive application of particular agricultural systems. In the short term, these problems may be solved by a variety of strategies from group mobility to technological innovation, but finding long-term solutions that successfully allow elites to increase production while avoiding resource depletion may be the exception rather than the rule. It may be that the tendency toward "chiefly cycling" which has been observed in the archaeological record (Anderson 1994; 1996; Gavrilets, Anderson, and Turchin 2010; Steponaitis 1978) is a near-inevitable

outcome of the precarious, environmentally-embedded political economy of social complexity. It seems probable that only with the increased managerial power and geographical reach of the state can resources and labor be organized with an accuracy and efficiency sufficient to provide more long-term political stability.

Chapter 3: Constructing a Model of Elite Strategies in Different Situations

INTRODUCTION

In order to apply the theory developed in the preceding chapter to the interpretation of archaeological evidence, it is first necessary to construct a model of the human processes the theory outlines. These processes relate and respond to a variety of both human and non-human factors, including population growth, elite activities, environmental conditions, and resource availability. The relationships among elite strategies and human and non-human factors are often recursive and contain feedback loops. Multiple strategies could be adopted at any given moment, leading to differing expected outcomes. The model is therefore a complex one.

Reflecting the theory in the preceding chapter, the model outlined in this chapter focuses on the economic aspects of elite power-consolidation strategies. This is not meant to imply that the producing segments of societies do not have their own economic strategies, which they are actively pursuing at any given moment, and which may contribute to, resist, or simply ignore the economic strategies of the elites. The elite focus of this model results from a concern with the maintenance of social complexity. The desire of elites to maintain their elite statuses is generally accepted (Brumfiel 1992; Earle 1997; Giddens 1979:189–190), and the model recognizes that the maintenance of elite statuses requires that elite individuals successfully practice at least some power-consolidation strategies, all of which have an underlying economic component. The model is not intended to be a complete representation of a political economy, nor to represent all economic strategies being practiced in a society.

Innovation, the creation or implementation of new technologies, ideas, and practices, also plays a key role in the model, introducing unexpected new variables. The

model does not attempt to explain why innovation sometimes occurs and sometimes does not, though this is a fascinating area of inquiry in anthropological research (Boserup 1965; Henrich 2001; O'Brien and Shennan 2010; Sawyer 2006).

KEY COMPONENTS OF THE MODEL

There are several key components that operate in the model in different ways at different times. It seems most practical to discuss each of these components independently first, before attempting to demonstrate how they operate together within the model.

Producer Mobility

Producer mobility is an essential orienting component of the model, and is represented as decreasing along the x-axis (see Figure 1). Several factors contribute to the level of producer mobility in a society, the most important being relative population density. Absolute population, by which I mean the number of people belonging to a group irrespective of any other considerations, can grow either through fertility or through the aggregation of additional members of society through persuasive techniques or capture, leading to potential increases in relative population density.

I use the term relative population density to refer to the number of people in a group as experienced by the individuals within the group. Based on culturally and environmentally specific factors such as the methods of information processing used by the group, the type of subsistence practiced by the group and the productivity of the local environment, the perceived availability of additional territory for subsistence or settlements, and the level of cooperation or competition experienced with neighboring groups, absolute population may be experienced as more or less dense. Within the model, relative population density functions much like Carneiro's classic concept of circumscription (1970; 1981), focusing particularly on the recognition that "circumscription" cannot be simply a function of absolute population and must instead be evaluated in terms of relative population density; the same area of land can easily support

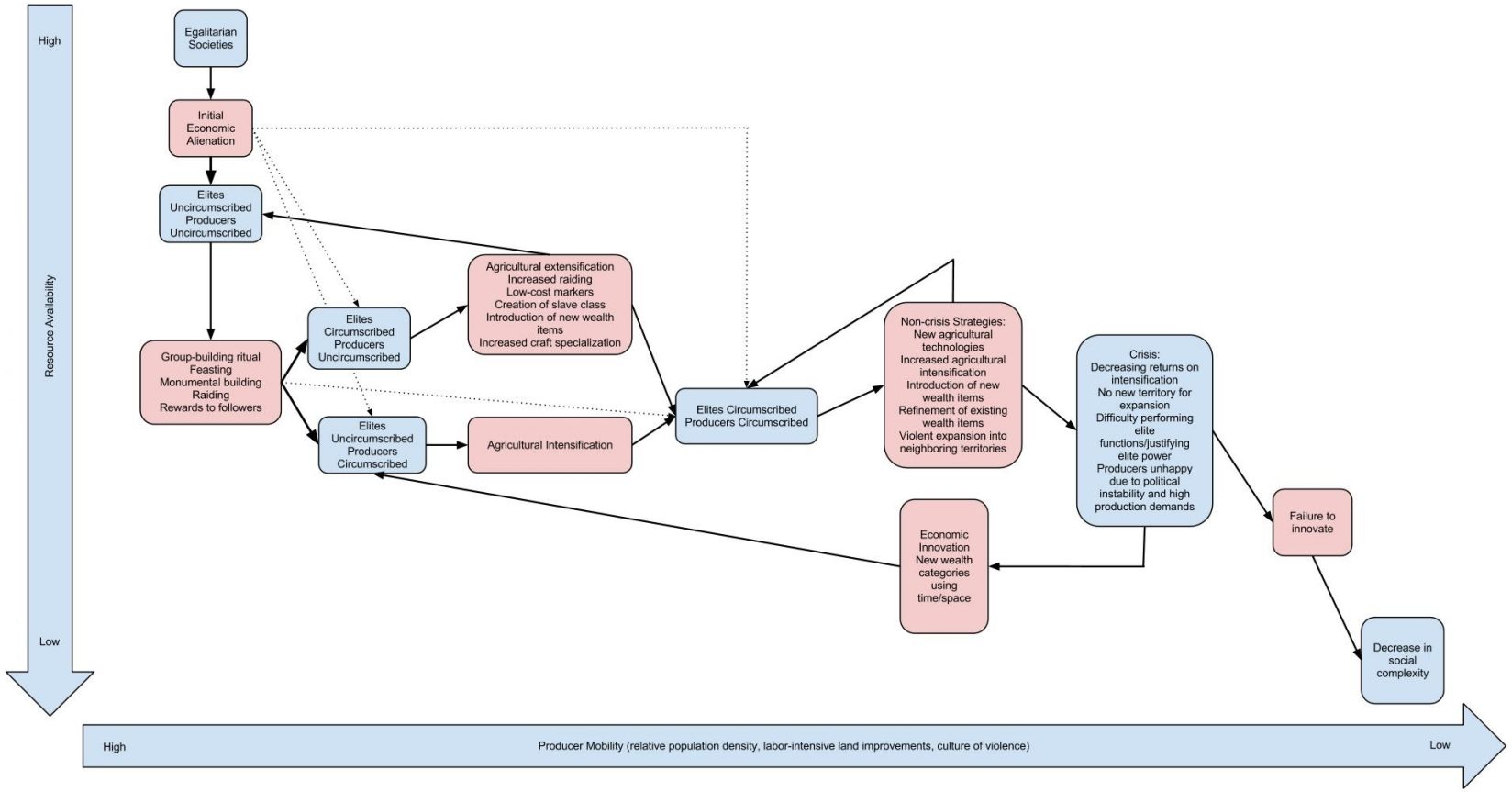


Figure 1: An economic model of the formation, growth, and decrease of social complexity

very different numbers of people depending on their subsistence practices, use of technology, and external networks (Carneiro 1970:737).

Within the model, relative population density operates to create the two different types of circumscription identified in the preceding chapter: producer circumscription and elite circumscription. A population that is small relative to the type of subsistence practiced and the productivity of the local environment creates a situation in which producers are not circumscribed. Additional land is available that can support splinter groups using the current subsistence methods, and producers may therefore exercise mobility to resist the demands of unreasonable elites, or elites who are not perceived to be acting at least partially in the producers' interests. A population that is large relative to the productive capacity of current subsistence practices and the local environment creates a situation in which producers are circumscribed. They cannot easily move around the landscape, and splinter groups may have trouble exercising mobility as a form of resistance to elite demands.

Relative population density is not the only factor that can limit producer mobility. As discussed in the preceding chapter, labor-intensive land improvements such as irrigation and terracing can also limit producer mobility (Adams 1966; Nichols et al. 2006; Wittfogel 1957), as can immoveable subsistence practices that require long-term investments, such as Mediterranean polyculture (Gilman 1981). The difficulty of recreating these improvements and reestablishing the related subsistence practices in a new area combined with the loss of production that occurs during the transition may effectively prevent producers from exercising mobility. Societies that rely on labor-intensive land improvements or high-investment immoveable subsistence practices to cope with geographical constraints may have circumscribed producers even if their relative population density is also low.

Finally, a shared culture of violence, in which intergroup raiding is common and undefended settlements are subject to attack (Chagnon 1968; Keeley 1996; LeBlanc 1999), is also an effective check on producer mobility. Violence can create producer circumscription in a situation in which relative population density and a lack of labor-intensive land improvements would leave producers uncircumscribed and free to exercise mobility to avoid elite demands. Because producer circumscription can be a desirable

situation for an elite attempting to harness producer labor for its own ends, as will be discussed below, creating a shared culture of violence can be a useful elite strategy to circumscribe an otherwise uncircumscribed population.

One aspect of producer mobility, relative population density, also has a relationship to elite circumscription, though the relationship is not direct. Because elites must draw the surplus labor or production necessary for their activities primarily from producers, a complex society's population must create sufficient production to meet elite needs, including the need to constantly increase elite displays (Steponaitis 1981; Trigger 2003:240). If population is insufficient to create this level of production, elites will feel circumscribed: unable to continue justifying their privileged position. However, as with producer circumscription, elite circumscription must be judged from within a culture, based on the particular goods and public activities used by that culture's elite to consolidate and justify their status. It is therefore necessary to relate population to elite circumscription through the medium of culturally-specific elite displays. It is also important to keep in mind that elite goods and activities often use resources that are not directly related to subsistence, meaning that there may not be a direct relationship between producer circumscription and elite circumscription.

A relationship between producer circumscription and elite circumscription often exists, however. In a situation where producers are circumscribed, elites are unlikely to be circumscribed as long as their basis for elite display is something that can be intensified through producer overproduction. A situation in which both producers and elites are circumscribed is likely to occur only in a resource-poor environment, or after elites have taken advantage of producer circumscription over a period of time to heavily exploit the available human and environmental resources. Such a strategy may eventually decrease the resources available to elites, limiting their ability to increase (Steponaitis 1981). However, because the negative outcomes of a system of overproduction are difficult to anticipate when first instituting the system, elites may see clear short-term benefits in creating producer circumscription and increasing production while being unaware of the potential long-term dangers. Again, it is important to note that the benefits of producer circumscription may encourage elites to create a culture of violence as a way to limit producer mobility (see Hadden 1999 for an example of such a strategy in the context of a

state).

Subsistence Base

The issue of subsistence is paramount throughout the model because of its complex relationships to both relative population density and resource availability. A given environment can support very different numbers of people depending on whether those people are foraging, practicing slash-and-burn horticulture or agriculture, or practicing intensive agriculture with crop rotation (Boserup 1965). Different types of subsistence also have different long-term effects on the environment, and the sustainability of any given subsistence practice, defined here as the ability to continue using a particular subsistence practice indefinitely, depends both on the appropriateness of the subsistence practice to the environment and the amount of production a group is attempting to achieve with it. The interaction of subsistence practices with population and with the environment are both key factors in the model, and thus warrant more explicit introduction before being addressed within the model itself.

First, the relationship between subsistence base and population is key to the model, and to the relationship between producers and elites within the model. It is in the producers' interests to practice a form of subsistence that is sufficient to provide for their own needs, including buffering strategies, but it is not in the producers' interests to overproduce beyond what will directly benefit them (Boserup 1965; Sahlins 1972:41–99). Overproduction in excess of producers' own ability to use their produce is a waste of time, and, cross-culturally, producers are aware of the high labor costs of intensifying agricultural production versus the low individual gain (Boserup 1965:31). This leads to an important distinction in likely production strategies depending on whether producers are circumscribed or uncircumscribed. In a situation in which producers are uncircumscribed, elites are unlikely to be able to get producers to intensify agricultural production. Intensification yields more produce per area of land but less produce per labor hour (Boserup 1965); as long as producers have the option of resisting increased demands on their time through mobility, encouraging agricultural intensification is not a reliable strategy for elites to increase the surpluses at their disposal.

In situations in which producers are not circumscribed, extensification rather than intensification is the more likely elite strategy for increasing agricultural surplus (Tachibana, Nguyen, and Otsuka 2001). For a small amount of additional labor input (relative to intensification), producers can achieve some additional surplus to contribute to elite displays. However, elites face both short-term and long-term obstacles to using agricultural extensification effectively. In the short term, elites must find ways to motivate extensification. Practically, this means providing rewards for producer effort. At the very least, elites must offer to organize enjoyable ceremonies that producers can participate in and that will increase group prestige, and elites are likely to have to be able to offer tangible individual benefits as well. Using extensification as an elite strategy makes high demands on elite labor and resources.

In the long-term, sustainable extensification relies on both population growth and territorial expansion. Population growth in the context of an extensifying strategy can occur through the fertility of the group or the aggregation of additional followers through elite strategies of persuasion. Fertility and follower aggregation can be slow processes, however, and both can suffer unexpected setbacks due to disease, crop failure, or intergroup raiding. Additionally, agricultural extensification must be accompanied by increases in available territory if it is to be a sustainable strategy, a problem that will be discussed in more detail below. The imperative for territorial expansion continues to place large demands on elite labor and resources, as elites are required to organize, arm, lead, and reward the men who fight for them. Thus, from the elite perspective, there are both short-term and long-term disadvantages to extensification as an economic strategy: extensification makes high demands on elite labor and resources and the increases it provides can be slow and unreliable. Relying on extensification for the surplus to justify elite position creates a political situation that is potentially quite unstable, as elite identity is threatened if surpluses cannot be maintained.

A third option for creating population growth and increasing surpluses is through the capture of non-group individuals through raids. These individuals can be added to the workforce to increase production. However, the capture of outside individuals also creates opportunities for the creation of a disenfranchised slave class, which may have outcomes that differ from the outcomes of simply adding additional people to the

producer labor force. A slave class is essentially a highly circumscribed sub-population of producers. Within a population of otherwise uncircumscribed producers, a circumscribed slave class creates opportunities for elite strategies which would otherwise be impracticable. A slave class may allow elites to adopt agricultural intensification on a small scale or to adopt the use of labor-intensive craft items for display or as rewards (Childe 1974:10–12; Earle 1982).

In situations in which producers are circumscribed, the more demanding practices of agricultural intensification can be enforced as long as the technologies of intensification are available (Boserup 1965; Smith et al. 1994). From the elite perspective, intensification has the enormous advantage of increasing the productive potential of the landscape. This allows for the collection of more surpluses in the short term, with minimal increases in the demands on elite labor and resources. As a long-term strategy of surplus creation, intensification is much more successful than extensification. Because intensification increases the productive potential of the landscape, it allows for population growth without creating an imperative for territorial expansion.

A second essential point of comparison between extensification and intensification involves the long-term sustainability of either strategy as a method of overproduction. Extensification can damage the resource base very quickly compared with intensification. Intensive agriculture relies on active soil conservation methods such as nitrogen replacement, crop rotation, manuring, and terracing to maintain soil fertility and prevent erosion, and only slowly leads to salinization and infertility. Extensive agriculture generally lacks soil conservation methods, relying on short periods of field use and very long fallow periods to replenish soil nutrients and prevent soil erosion. While both intensive and extensive agriculture can be sustainable, extensive agriculture is only sustainable for lower levels of production relative to total area. The processes of soil damage that accompany the overuse of extensive agriculture can rapidly destroy the land's productive potential. High levels of production relative to total area have been shown to be sustainable over very long periods of time when the soil-conserving methods of intensive agriculture are practiced conscientiously (Butzer 2005).

The difference in long-term sustainability between extensive and intensive agriculture has important implications for strategizing elites. In a situation in which

producers are uncircumscribed and elites cannot force producers to adopt intensive agriculture, increasing production by expanding extensive agriculture may seem like a necessary strategy for increasing elite surplus. Although field clearance, particularly of secondary growth, is not an insignificant cost, expanding extensive agriculture may still be less costly and easier to motivate than the adoption of intensive agriculture, and there are many ethnographically recorded examples of existing methods of agricultural production being expanded to supply feasts or rituals (Spielmann 2002:197). However, expanding extensive agriculture can rapidly deplete the local resource base, putting elites in the difficult position of experiencing diminishing returns of surplus and potentially causing subsistence problems for the entire group. Increasing surplus production through agricultural extensification is unlikely to be a viable strategy for long.

Resource Availability

A final key component of the model is resource availability. As with population and subsistence base, resource availability can only be evaluated relative to particular cultures and technologies in specific environments. Resource availability depends on what a culture produces and how it produces it. As has been discussed previously, the same amount of agricultural land represents different resource availability depending on whether a culture is practicing extensive or intensive agriculture. Land that is unproductive based on an agricultural economy may be highly productive in a pastoral economy.

In evaluating resource availability, it is essential to define what is meant by "available." Resources that exist in the environment can only be considered available if they are incorporated into some part of the economy: large amounts of copper ore are not a resource available to a culture with strictly lithic technologies. However, it is necessary to recognize that resources that are not available at a specific point in a culture's trajectory may become available at a later date, when new technologies have been developed or learned. The availability of these newly-important resources can have a strong impact on a culture's trajectory, such as when a relatively unconnected Neolithic village near metal resources becomes a trading hub after metalworking technology is

developed. I will therefore make a distinction between potential resources, resources that are in the environment but not yet available to the environment's inhabitants, and available resources, the resources that are actively being exploited at any given moment.

The relationship between potential resources and available resources has important implications for the model, particularly in terms of innovation. If a society overuses its available resources, it may need to incorporate more of its potential resources into its economy or else face an economic crisis, resulting in emigration to a less depleted area or a decrease in social complexity. The ability to incorporate a potential resource depends on some kind of innovation, at least in perception and perhaps also in technologies. To incorporate a previously unused resource such as a particular type of feather, animal skin, or antler may only require that elites introduce it creatively into existing rituals and displays and, by repetition, affirm its significance and importance. Other resources, however, such as metal ores, can only be introduced into the economy through discovering or adopting innovations in technology. This process is clearly not entirely voluntary; the need for additional sources of social value may be felt before the technology to exploit some kinds of potential resources becomes available. In a heavily depleted environment, one in which most potential resources are already being exploited as available resources, or one in which the technology to exploit potential resources is not available, elites may need to tap into the inexhaustible resources discussed in the previous chapter: distance and time.

CONSTRUCTING THE MODEL

Using the key components discussed above, I will now discuss each section of my proposed model in detail, illustrating how each of the components interacts with the circumscribed or uncircumscribed states of elites and producers to encourage sets of elite strategies with specific possible outcomes.

Initial Economic Alienation and Early Social Complexity

The model begins with egalitarian societies, which at some point experience

economic alienation through the processes discussed in the preceding chapter. The model does not attempt to examine economic alienation in detail, but it is worth mentioning that it is a complex process taking place in most transegalitarian societies (Prentiss and Kuijt 2004; Price and Feinman 2010; Tuzin 2001). Most transegalitarian societies contain individuals with recognized leadership positions that they may be able to manipulate into statuses with greater amounts of economic control and fewer reciprocal economic obligations. Clan and lineage heads are particularly likely to hold positions that can be leveraged into elite statuses, but ritual specialists and holders of other specialist positions may also be able to leverage the control of their specialty into greater economic rights (Ames 2008; Wright 1984).

In practice it is probably impossible to state clearly whether full economic alienation has taken place in many ethnographically-known transegalitarian societies. It is worth asking how important is the difference between *de facto* economic alienation, in which some members of society do not have access to a good even though there is no rule preventing them from owning it, and formal economic alienation, in which societal rules recognize that some members of society have no access to a particular good. It is also worth questioning the clarity of the division between societies with developing economic alienation and societies with developed economic alienation. What are the differences between influential individuals with no formal authority and elites with socially recognized distinct status?

While these are important and interesting questions, they fall outside the scope of the current work, and the proposed model does not attempt to address them. Like all models, my model simplifies some complex processes and ignores some important questions. This is not meant to deny the significance of these processes or the importance of these questions, but my primary concern in this work is to understand the economic processes by which social complexity grows and is maintained. The intricate processes of initial economic alienation are by no means fully addressed here. For the purposes of this study, I substantially elide the development of economic alienation. However, it is worth mentioning that many of the strategies pursued by incipient elites in this model probably also pertain to influential persons in transegalitarian societies (Ames 2008).

The focus of the proposed model concerns what happens after economic

alienation first occurs. It is possible for initial economic alienation to lead directly to any of the four elite-producer situations identified in the preceding chapter. In areas where resources are highly concentrated such as the floodplains of desert rivers, the vicinities of highly productive salmon runs, or very small islands, producers may be circumscribed even before economic alienation occurs. If elite identity is based on very rare or difficult-to-obtain resources, elites may also be circumscribed from the beginning. However, in most environments, resources will be distributed broadly enough and relative population density will be low enough that producers will be uncircumscribed. Similarly, elite identity is likely to be based on subsistence resources immediately after economic alienation, meaning that elites will also be uncircumscribed. While the model acknowledges that economic alienation can lead directly to any of the four circumscribed/uncircumscribed combinations, the elites uncircumscribed/producers uncircumscribed situation is considered to be the most likely.

In a situation in which producers are uncircumscribed, elites must rely more heavily on their own initiative and labor to build their elite identity and consolidate their power. If elites are also uncircumscribed, however, there are opportunities for them to engage in such identity and power creation. Immediately following economic alienation, many fairly simple strategies are available to elites that do not require large inputs of group labor. The establishment of residential and/or mortuary segregation is one such strategy for building elite identity (Peebles and Kus 1977).

However, in addition to establishing and reinforcing an elite identity, new elites must also consolidate their power. When producers are uncircumscribed, power must be based on persuasion and the attractiveness of following the new elite (Beck 2003; 2006). Elites must motivate loyalty and labor contributions, rather than demand them (Sahlins 1963; Strathern 1971; Tuzin 2001). Elite strategies to aggregate followers must therefore accomplish several goals: they must create corporate identity with the elites as the leaders, create a sense of dependency on the elites, and create a sense that elite privilege is deserved (Gramsci 1972). The model proposes several strategies that elites can use to accomplish these goals: giving rewards or gifts to followers (Boas and Codere 1966; Ekholm 1972; Sahlins 1963; Strathern 1971), holding feasts (Arnold 1996b; Dietler 1990; Dietler and Hayden 2001; Potter 2000), leading group ritual (Spielmann 1998), and

raiding (Flannery and Marcus 2003; Junker 1999).

When elites give rewards or gifts to loyal followers, they both encourage producers to feel dependent on them and emphasize that their own position of privilege is deserved. Producers, who may have difficulty acquiring agricultural surpluses or culturally desirable goods through their own productive labor, may have greater access to these goods through loyal service to the elites (Brumfiel and Earle 1987; Earle 1997; 2002; Frankenstein and Rowlands 1978). The elites reward loyal service with gifts, and a sense of dependency is created: producers rely on elites to provide goods that they otherwise cannot have. In turn, elite privilege is justified by the elites' greater moral qualities. Elites appear generous and helpful, taking care of the producers and contributing to their well-being.

Elites holding group feasts operates in a way similar to gift-giving, though at the larger scale of the group rather than at the smaller scale of the individual. Elites expend both effort and resources in organizing feasts, and the public nature of the feasts emphasizes elite generosity in doing so (Hayden 1996; Wright 2004). The group nature of the feasts helps create a corporate identity with the elites as the leaders. The fact that feasts provide some material benefit to producers in the form of surplus food as well as the fact that they are enjoyable social occasions may encourage producers to feel dependent on elites to provide these events.

Elites may also take a greater role in ceremony, taking on organization responsibilities and leadership positions in group ritual. This creates a corporate identity that acknowledges the elites' membership within the group, but it also emphasizes the elites' primary position as group leaders. Elites leading group ritual also encourages producers to feel dependent on the elites, both in practical terms as the organizers of the rituals and in religious terms as intermediaries with the spirit world. The extra effort expended by elites and the important spiritual position held by elites with respect to ritual activity also serves to create the sense that elite privilege is justified.

Finally, elites may organize raiding activities. Raids contribute to all three elite goals, first by creating a sense of corporate identity with the elites as the leaders, second by creating a sense of dependency on the elites to carry out the raid successfully, and third by appearing to justify elite position by showcasing their superior bravery and

tactical skills. However, raiding, unlike the other three elite strategies, also provides a material benefit to the elites themselves in the form of captured goods. The elites can distribute these goods as rewards to members of the raiding party, save them to give as gifts to other loyal followers at later dates, or simply amass them as a display of their prowess. If people are also captured during raids, elites have an opportunity to establish a completely disenfranchised slave class that can be made to labor to support elite activities while requiring fewer rewards than producers. Raiding can significantly benefit elites, both in terms of establishing their position within the group and in terms of providing material gain. As such, it is likely to be a popular elite strategy, especially when producers are uncircumscribed and heavy demands cannot be made on group members.

If raiding is pursued actively and neighboring groups are in a position to respond in kind, a culture of intergroup violence may result (Carneiro 1981; LeBlanc 1999). A culture of intergroup violence may in turn limit producer mobility, creating a situation of producer circumscription. Although it is probably unlikely that many elites anticipate this outcome when they begin leading raids against their neighbors, hastening a situation of producer circumscription can have important benefits for the elites, making it possible to make greater demands on producers long before population growth alone would have limited producer mobility.

Growing Social Complexity and the Beginnings of Circumscription

Two situations are likely as the early stages of social complexity progress. First, population growth or the development of intergroup raiding may outstrip the elite need for increasing surplus, leading to a situation in which producers are circumscribed and elites are uncircumscribed. Alternatively, the elite need for increasing surplus to maintain their position may outstrip population growth or other factors which cause high relative population density, leading to a situation in which elites are circumscribed and producers are uncircumscribed. It is also possible, particularly in spatially circumscribed environments with high relative productivity, for population growth to be rapid with the simultaneous effect of diminishing the amount of surplus that can be collected by elites, leading to a situation in which both producers and elites become circumscribed soon after

the initial formation of social complexity. However, this situation is probably limited to very specific cases, and the model considers the two preceding possibilities to be the more likely outcomes.

In a situation in which producers are circumscribed and elites are uncircumscribed, elites are likely to focus on strategies that will maximize the amount of surplus they can collect while avoiding possible losses. Agricultural intensification is probably the most applicable strategy. When producers are circumscribed, elites can exert more overt pressure because producers are unable to simply move away from elite demands. Elites are also aided in their attempts to establish intensive agriculture by the obvious benefits of more agricultural production, made desirable by the increased consumption needs of the larger population in a situation in which population growth has caused producer circumscription, or by the obvious advantages of intensive agriculture over extensive agriculture in a situation in which intergroup raiding has caused producer circumscription. Smaller, intensively farmed plots located close to the settlement are much easier to monitor and defend than numerous plots spread out over a large area at a distance from each other and from the settlement.

A situation in which elites have stopped being able to extract increasing surplus from producers but producers are still uncircumscribed is a difficult one for elites. Elites are unable to encourage or enforce a transition to intensive agriculture, but must find some way to increase the amount of surplus at their disposal or else risk losing their position. Agricultural extensification is one option, with the extra producer labor required for extensification being motivated through the pre-existing system of gifts and rewards. Increased raiding is another option. If low-cost status markers like residential and mortuary segregation have not already been adopted, elites are likely to adopt them at this point. Finally, elites may use prisoners captured in raids to create a slave class. This circumvents the lack of producer circumscription by creating a class of people who are circumscribed by definition. Slave labor can be commanded rather than motivated and may not be rewarded, or may not be rewarded as highly as producer labor. This creates a source of more reliable, cheaper labor that elites can exploit to perform tasks that producers would resist. The creation of a slave class may allow elites to begin transitioning to intensive agriculture, or slaves may be required to help produce or

construct new labor-intensive status markers.

A final strategy that elites may use when they are circumscribed and producers are uncircumscribed is to create new wealth items. The introduction of new wealth items into the political economy expands elites' options considerably. The new items may be collected and displayed to bolster elite identity or they may be distributed to producers as part of the system of motivation. Additionally, the acquisition or production of wealth items may be considered a particularly elite activity (Helms 1993). If the wealth items are distant (Helms 1988) or dangerous to acquire, they may have extra efficacy in reinforcing elite identity.

It is important to note that one of the potential feedback loops in the model occurs here. If circumscribed elites can successfully solve their circumscription through new economic strategies, they may return to a situation in which both producers and elites are uncircumscribed.

Established Social Complexity and Growing Circumscription

When a complex society is well established and its political economy functioning, it tends to move along the trajectories of decreasing producer mobility and decreasing resource availability. Producer mobility almost inevitably decreases as group fertility causes relative population density to increase. Resource availability tends to decrease as more land is brought under cultivation, other renewable resources are exploited more extensively, and non-renewable resources are consumed. If these trajectories continue, a society will eventually encounter a situation in which both producers and elites are circumscribed.

A situation in which both producers and elites are circumscribed presents serious difficulties for the expansion of the system. Producers are already farming intensively and elites are running out of the surpluses and status goods they need to continue justifying their position. Much of the land that can be farmed is already being farmed, so simply expanding the amount of land under cultivation is not a long-term solution. In this situation, elites have few options. They can begin by expanding agriculture into those few areas that are not yet cultivated, but ultimately they must be able to implement new

agricultural technologies that make unproductive land productive, whether in the form of management systems that increase productivity or in the form of new crops or livestock that can thrive in previously unexploited environments. Only improvements or additions to the repertoire of agricultural strategies can create a sustained increase in surpluses.

Another option that is always available to elites is the introduction of new wealth items. However, this strategy relies on the presence of still-untapped potential resources in the environment that can be transformed into elite goods. Unless a new technology such as metalworking has become available, the likelihood that there are unused potential resources that can be used to create elite goods is low; most potential resources will already be in the system as available resources. A more likely strategy is the refinement of existing elite goods through more specialized craft production (Helms 1993). The visual impact of noticeably finer wealth items can function like an increase in surplus in terms of justifying elite position, and in a system in which both elites and producers are circumscribed, human labor may be the most abundant resource available for more intensive use. Such high-value production may also increase the ability of elites to engage in external trade/exchange, an additional method of increasing the amount of social value elites can manipulate by adding exotic and foreign goods to the repertoire of elite display strategies.

A final option available to elites is the violent takeover of neighboring territories (Carneiro 1970; 1981; Gavrilets, Anderson, and Turchin 2010; Wright 1977). If it is impossible to increase surplus in the current territory, adding more territory may be the most straightforward way to access more goods. In essence, violent takeover is an intensification of the raiding strategy in which the economic objective of the raid shifts from the acquisition of moveable goods and people to the incorporation of the entire productive system. In a successful violent takeover, the conquering elite can redirect to themselves much of the surplus that was formerly paid to the pre-existing elite. The conquering elite can also raise production expectations backed by the trauma of the recent invasion and the fear of more violence.

If elites are successful in instituting any of the above strategies, a feedback loop takes place in the model. If elites are highly successful, the society may return to a state in which elites are uncircumscribed while producers are circumscribed. If elites are

moderately successful, they will remain in a state in which both elites and producers are circumscribed. It may seem counter-intuitive that elites can be successful in their strategizing but not improve their economic position, but it is important to note that, throughout the model, elites are in a position similar to Alice in the Red Queen's race: they must run very hard simply to stay in one place.

Crisis in the Political Economy and the Need for Economic Innovation

It should be clear by this point in the model that elites are caught in something of an arms race. They must constantly increase the amount of surplus and/or wealth items they can control simply to maintain their elite status. Eventually, as population grows and resources are heavily utilized and potentially depleted, the need for increasing production leads to a crisis in the political economy. Elites find themselves unable to increase production with any currently available means. There are decreasing returns on agricultural intensification (Tainter 2006) and no new territories to expand into. As increases in production fail, elites have difficulty "outdoing" themselves, leading to comparatively less impressive displays. Ritual also suffers as powerful elites are unable to make sufficiently impressive ceremonies and offerings for the gods. Minor members of the elite class may take the slackening pace of elite and ritual displays as a sign of weakening power and begin to challenge established leadership. Producers notice the decline in elite and ritual displays and the beginnings of elite in-fighting and become dissatisfied with the political and religious instability coupled with high production demands.

In order to regain stability in a crisis situation, elites must innovate some new part of the political economy that can be intensified without drawing on the already taxed resources available in the system. If new technologies can be learned or discovered, previously potential resources can become available, opening up new possibilities for production. However, in the absence of new technologies that can be adopted, some other innovation is required.

Even in the most depleted environment, distance and time remain potential resources that can be intensified indefinitely. In most complex societies, distance and

time are utilized to some degree from an early point: elites remember and reference their lineages and exotic goods are prized as part of elite displays. However, even in situations where distance and time are already available resources, they have the advantage of being inexhaustible. For any pre-industrial society, distance might as well be infinite, and nothing stops time from passing and, if remembered or recorded, accruing.

The use of distance in a political economy, represented by exotic goods, foreign knowledge, or both, can be intensified in any situation except one in which a society is truly isolated, as in the case of Easter Island. Intensifying the use of distance can take the form of importing more exotic goods; however, this strategy may cause inflation over time unless the exotic goods are fragile and likely to decay or break with use. The devaluing of already-exploited exotic goods through excessive importation may actually be one of the reasons a political economy finds itself in crisis. Therefore, the intensification of distance in a crisis situation is likely to mean the incorporation of exotic goods from even more distant places rather than simply more goods from already-exploited distances.

Time is probably the most available resource, because unlike distance, there is no situation in which time is not a potential or available resource whose use a society can incorporate or intensify. Elites often incorporate time in their strategies of privilege justification and identity-building during or shortly after the development of social complexity, which means that the use of time in a crisis situation must take some other form to be effective. The creation of elite objects with remembered histories is one such solution that requires no additional resources except time and memory, making it an ideal innovation in a heavily utilized environment in which available resources are already being exploited intensively and further intensification is impossible. Objects that gain in value depending on how old they are (Thomas 1991:67), who has owned them (Gosden and Marshall 1999; Malinowski 1932), and how they have been used can increase in value indefinitely. Such storied objects may be traded, fought for, or simply curated and displayed. In any of these situations, the objects serve as the inspiration for elite activities such as trading voyages, raids and armed conflicts, and ceremonies. The successful organization of such activities continues to justify elite status, while the ownership and display of the storied objects builds elite identity and prestige. Because the objects

increase in value based on ownership, use, and time, they are constantly accruing additional value, making them a quasi-inexhaustible source of social value available to elites. Although the production or acquisition of valuables that accrue social value based on time is ultimately tied into and reliant upon the system of agricultural production, the cost of acquiring older valuables may be no greater or only marginally greater than the cost of acquiring newer valuables (presumably the cost of the voyaging equipment does not change and the opportunity cost and the cost of supplies may increase somewhat based on the number of additional days in the voyage and the expectation that supplies cannot be acquired along the way). This means that agricultural production may remain more or less stable, preserving the resources that support agricultural production from the diminishing returns of overuse, while elites may continue to increase the amount of social value at their command. Additionally, because the objects are more and more likely to break or be lost over time, inflation is not a threat to the objects' value.

Points of Failure

There are stable pathways within the model, demonstrating that with the correct strategies and economic innovations, social complexity can grow and be maintained indefinitely despite the heavy toll the maintenance of social complexity takes on available resources. However, there are also many points in the model at which elites may fail to continue justifying their position and society may experience a decrease in social complexity. It is important here to distinguish between the failure of specific elites or groups of elites, which may result in a shift in who holds power, and a genuine systemic failure in which a level of power is lost entirely.

Elites uncircumscribed/producers uncircumscribed

Social complexity may be very unstable in a situation in which both elites and producers are uncircumscribed; however, outright failure to maintain social complexity – to experience a systemic failure – is probably unlikely due to the large amount of resources available. Producers may find social complexity desirable and advantageous at

this stage, since elites provide numerous benefits in terms of building group identity, organizing ceremony, encouraging group sociability, and improving group prestige. Producers are likely to find small contributions of surplus and labor acceptable in return for these elite services. However, complex societies under these economic conditions may experience large shifts in power as incipient elites compete with each other for the loyalty of the available producers.

Elites circumscribed/producers uncircumscribed

A situation in which producers are uncircumscribed while elites are circumscribed is probably the most difficult situation in which to maintain social complexity. In this situation, more demands are made on elites than on producers. Elites must come up with strategies and goods to motivate producer contributions of surplus and labor without overtaxing the producers, which could cause them to migrate to other groups. The pressures on elites in this situation encourage them to rapidly overuse easy-to-exploit resources without being able to institute the time- or management-intensive conservation practices that would be practicable if producers were circumscribed and a greater degree of command were possible. Elites may rapidly come to depend on raiding to acquire the necessary goods to maintain their position, a strategy which is unlikely to maintain power within specific elite lineages for much more than a generation or two due to its reliance on the heritability of tactical skill. Should a specific elite fail under these circumstances, lack of resources may prevent another elite group from being able to fill the power void.

Elites uncircumscribed/producers circumscribed

A situation in which elites are uncircumscribed while producers are circumscribed is probably the most stable in terms of growing and maintaining social complexity. Elites are able to collect larger amounts of surplus while taking care to preserve resources through agricultural intensification and enforceable resource-management strategies. The greatest difficulty faced in this stage may be the transportation costs of carrying bulky agricultural surpluses to elites as the size of the society grows, but this problem can be solved relatively simply by establishing a peripatetic elite, as in the example of the

Hawaiian chiefdoms, or by relying more heavily on wealth items as the medium of producer contributions (D'Altroy and Earle 1985).

Elites circumscribed/producers circumscribed

A situation in which both elites and producers are circumscribed is probably the second most likely situation to fail. Managing this situation requires serious technological innovation, whether in agriculture or craft production, or if the environment is already heavily exploited, in inexhaustible resources such as distance and time. Elites' ability to come up with these innovations and to implement them effectively is undoubtedly affected by group creativity, intra- and inter-group information and transmission networks (Henrich 2001), and the effectiveness of elites at instituting new practices. If elites fail to adopt new technologies quickly and thoroughly enough, they are likely to be unable to maintain their position, and loss of some level of social complexity is likely. In a complex chiefdom, this may take the form of constituent chiefdoms regaining their autonomy (cf. Blitz 1999). In societies with low levels of complexity, elite status may be rejected, simply disappear, or become irrelevant for a time as producers return to a state of autonomous decision-making (Leach 1970).

CONCLUSIONS

The model presented here distills the theory discussed in the previous chapter into a clear, concise outline of the processes and strategies involved in the maintenance of social complexity. The model uses the differentiation between elite circumscription and producer circumscription to identify particular economic situations and the elite strategies likely to result in each of these situations. When implemented successfully, these elite strategies create feedback loops which return the society to a previous point in the model or at least allow it to stay in the same place. One of the strengths of the model is that it demonstrates that there are multiple possible outcomes for each economic situation, and that these outcomes are based on human agency, problem-solving, and innovation. Although the model is clearly set against a background of influencing factors, namely resource availability and relative population density, these factors are not deterministic.

Rather, they are parameters that limit what economic strategies can be enacted and for how long the given strategies are sustainable. Overall, however, the model does identify a basic trajectory of economic situations and strategies that complex societies face. Complex societies that successfully maintain complexity in the long term will pass through at least three of the four identified situations.

The model is written to address the strategies and perspectives of the elites of societies. If we assume that elites never want to lose power and always hope to gain more, then we must acknowledge that there are "right" and "wrong" answers in the model, at least for the long term. Elites can follow unhelpful strategies that destroy their own resource base. They can fail to innovate successfully and be unable to acquire the resources needed to maintain their position. They can, through no fault of their own, establish economic alienation in an environment where high producer mobility and moderate resource availability make it simply impossible for them to gather enough resources to maintain their position over time. From the elite perspective, complex societies can and do fail.

However, the elite perspective is not the only perspective, and in most complex societies, the elite is not a single monolithic entity. From the producer perspective, a decrease in social complexity may be desirable, freeing up producer resources and giving producers more autonomy over the distribution of their own labor. Additionally, minor elites may hope to gain or regain power at the expense of the controlling elites. For example, the constituent chiefs of a paramountcy may be pleased with the greater amount of power and resources they control individually when the paramountcy fails. Although the model does not explicitly incorporate the strategies of resistance that may be employed by producers and minor elites against the interests of the controlling elites, it is not meant to deny that these strategies exist. The resistance of producers and minor elites is a factor that controlling elites may have to face at any point in the model. Therefore, though a decrease in complexity is a failure of the system in terms of the model presented here, an alternate and equally valid model could be presented in which a decrease in complexity represents a success for strategizing producers: one person's collapse is someone else's rise to power.

Section II: Case Study: The Siddi Plateau in the Middle Bronze Age (ca. 1750-1365) of Sardinia

Chapter 4: Introduction to the Case Study

Testing the model outlined in Section I requires an archaeological case study. The case study should provide evidence of elite economic behavior in the context of developing or increasing social complexity. For the case study to have the greatest chance of being effective, it needs to come from an area of the world where resource degradation can happen quickly and where evidence of resource degradation is likely to be archaeologically visible.

The early development of the Nuragic culture during the Middle Bronze Age on Sardinia (c. 1750-1365 BCE) provides just such a case. During the Sardinian Middle Bronze Age, the first evidence of growing inequality appeared on the island. Influential leaders of some kind began aggregating labor to build impressive stone platforms and towers called corridor nuraghi. These monumental structures served as dwellings and perhaps storage units for a small segment of the population that built them, indicating societies in which individuals within the group had unequal access to prestige and resources.

The inequality of the Middle Bronze Age developed out of the relative equality of the Sardinian Neolithic and Eneolithic. During the Neolithic and Eneolithic, slight differences in prestige and access to resources are indicated by differences in house sizes and occasional finds of beads or copper and silver burial goods, but there are no archaeologically visible categories of belonging or exclusion. The development of monumental building in the Middle Bronze Age is the first indication of categorical divisions in Sardinian prehistoric society.

The social meaning of the corridor nuraghi is not entirely clear from their distribution, size, and construction. Corridor nuraghi are sometimes found singly, but are more often found in clusters of two or more, indicating a repeating social process occurring at roughly the same time throughout much of the island. The corridor nuraghi clearly represent the aggregation of labor; though they appear to be individual family

dwellings, it is impossible that every Middle Bronze Age family had its own corridor nuraghe (*contra* Webster 1991; 1996). This inequality in access to labor and resources could indicate the increasing power of lineages and lineage heads, but not indicate that true economic alienation had taken place in Middle Bronze Age Nuragic society. Understanding whether the corridor nuraghi indicate economic alienation requires a more in-depth archaeological study of the populations living in them.

The development of inequality in Middle Bronze Age Sardinia occurred within a potentially fragile environment, one in which overuse of resources – particularly agricultural resources – was likely to affect the resource base rapidly and noticeably. The susceptibility of Mediterranean environments and soils to the deleterious effects of extensification (erosion and loss of soil nutrients), irrigation (salinization), and overgrazing (erosion) have been widely noted (Abahussain et al. 2002; Butzer 2005; Vasey 1992). Sardinia, with its poorly-developed hydrology, is particularly susceptible to drought, which occurs about twice as frequently as in other areas of the Mediterranean (Lewthwaite 1986). The frequency of drought on Sardinia increases the likelihood that loss of ground cover due to agriculture would result in high levels of soil erosion, and also suggests that the processes of soil salinization would occur rapidly if irrigation were used to combat low levels of rainfall.

The combination of developing inequality in a fragile environment makes the Middle Bronze Age of Sardinia an excellent case study for applying the model proposed in Section I. Unfortunately, the possibility of rigorously studying the development of inequality, patterns of resource use, and potential resource degradation in Middle Bronze Age Sardinia has been impeded by the lack of information available about the Middle Bronze Age. Most excavations have focused on the larger, more impressive sites of the Late and Final Bronze Age. There have been very few survey projects on Sardinia, and those that have been conducted have focused mainly on the Iron Age and subsequent periods (Van Dommelen 1998; Dyson and Rowland 1992). Applying the proposed model to Middle Bronze Age Sardinia therefore requires additional information and new fieldwork.

A MIDDLE BRONZE AGE SETTLEMENT SYSTEM: THE SIDDI PLATEAU

The settlement system found on – and presumably around – the Siddi Plateau provides a specific region in which to conduct new research on the Middle Bronze Age of Sardinia. The Siddi Plateau, a steep, irregularly-shaped plateau about 12 km^2 located in the south-central Medio Campidano region of Sardinia (Image 1) in an area known as the Marmilla (see Chapter 5). There are sixteen corridor nuraghi and one monumental tomb on the Siddi Plateau, all likely to date to the Middle Bronze Age based on architectural styles and limited finds of Middle Bronze Age pottery. These sixteen nuraghi are the result of labor aggregation and possibly competition among lingeage heads or early elites. The settlement system of the Siddi Plateau thus offers multiple opportunities for the recovery of data relating to the economic strategies of incipient elites.

Image 1: The location of the Siddi Plateau in Sardinia, indicated by a red circle, and a closeup of the plateau.

Additionally, excavations addressing the Late and Final Bronze Age on another plateau with similar geology produced good pollen data (López, López Sáez, and Macías 2005), allowing a preliminary reconstruction of the ancient local environment. The effects of soil on pollen preservation could be expected to be similar at Siddi Plateau given the shared geology. The promise of good pollen data suggested that environmental

reconstruction would be possible at the Siddi Plateau.

The subsequent chapters in this section of the dissertation will further contextualize the case study by offering a detailed discussion of the geography, natural resources, and climate of Sardinia with special reference to the Siddi Plateau region (Chapter 5), followed by a discussion of the culture history of Sardinian prehistory, including what is known about the development and trajectory of the Nuragic culture (Chapter 6). Chapter 7 will then provide a more detailed introduction to the archaeology of the Siddi Plateau and discuss the research design and overall results of the new archaeological project undertaken on the plateau. Finally, Chapter 8 will discuss the results of the project in detail and apply the proposed model to interpret the results.

Chapter 5: The Geological and Environmental Context of Prehistoric Sardinia

INTRODUCTION

Using socioeconomic and cultural developments on Sardinia during the Middle Bronze Age as a case study for the proposed model requires understanding these developments against an environmental background. The subsistence resources available to prehistoric people, the climatic and hydrological conditions that affected the year-to-year availability of those resources, and the soil conditions that affected the long-term ability to sustain, extensify, or intensify subsistence production must all be considered in a model of the feedback between economic strategies and incipient social complexity. The location and the ease of extraction of raw materials for building and craft production - basalt and granite, workable stones, and metal ores - must also be considered when evaluating the demands that building and craft production made on time, labor, and exchange networks. This chapter will contextualize the chosen case study by providing an introduction to the geology, hydrology, and climate of Sardinia with particular reference to the Siddi Plateau.

GEOLOGY

With an area of about 24,000 km², Sardinia is the second-largest island in the Mediterranean, only slightly smaller than Sicily. It is part of the Sardo-Corsican massif, a single outcropping of Hercynian granite. This shared geology can be observed during glacial maxima, when recessions in sea level cause the Straits of Bonifacio to dry up, and Sardinia and Corsica become a single, very large island.

The granite foundation of the Sardo-Corsican massif finished forming about 250 million years ago, when it was still a part of mainland France and Spain (Massoli-Novelli 1986:3). While this Palaeozoic granite surfaces in much of Corsica and in some part of

Sardinia, subsequent geological activity in the Miocene and later in the southern part of the Sardo-Corsican massif has given Sardinia a much more varied geology (Webster 1996:28). Miocence sea deposits such as marls, limestones, sandstones, and clays are found in much of the island. Later deposits of basalt, trachyte, and trachytic tuffs were formed by volcanic activity in the Pliocene. Still later, Quaternary alluvial deposits have created lowland plains.

Topographically, much of the island consists of high hills and mountains (see Image 2). The highest mountains are the mountains of the Gennargentu, located in the east-central part of the island, where the peaks reach up to 1800 m asl. Lower mountains with peaks around 1200 m asl, the Monti di Alà, the Goceano, and the Marghine, form a diagonal chain across the north of the island, and the Iglesiente and Sulcis mountains make up a region in the southwest of the island. Despite the fact that mountains are widespread across Sardinia, their orogenesis varies, particularly that of the Iglesiente mountains. The only major lowland regions are the plains of the Campidano, which stretch from the Gulf of Oristano south to Cagliari, and the small Nurra plain north of the Gulf of Alghero. Separating the plains of the Campidano from the mountains of the Gennargentu is a hilly region called the Marmilla, characterized by hills and plateaus ranging from only a little above sea level in the valleys to just below 600 m asl on the high plateaus. The soils of the Marmilla are heavy but fertile; currently, the primary economic activities in the Marmilla are grain agriculture, viticulture, orchards, and pastoralism.

The major geological regions of Sardinia are therefore quite heterogeneous, creating an uneven distribution of resources that must have affected ancient Sardinians' choice of settlement locations and their patterns of procurement and exchange. The following sections will discuss the types and locations of Sardinia's geologically-based natural resources.

Image 2: Major topographical regions of Sardinia

Soils

Understanding the distribution of soils on Sardinia is essential for understanding the influence that types of soil and their locations may have had on prehistoric settlement patterns and subsistence strategies. However, it is also important to keep in mind how soils may have changes over the past several millennia. This section will begin by discussing the types of soils currently present on Sardinia and their agricultural potential. It will then discuss whether contemporary soil patterns can be used to reconstruct prehistoric soil patterns.

The soils of Sardinia (Aru et al. 1990; Jones, Montanarella, and Jones 2005) are predominantly Cambisols, young soils that can be highly agriculturally productive. Eutric Cambisols are the most common, though Eutri-andic Cambisols, Chromic Cambisols, and Calcari-vertic Cambisols are also present. These Cambisols are found throughout the north of the island, from Alghero to Olbia, and along the east coast stretching down to the south coast at Villasimius. Cambisols also predominate in the region of the Iglesiente.

The Cambisols are interupted by patches of Luvisols (Gleyic, Chromic, and Calcic) and Dystri-lithic Leptosols. Luvisols occur in well-drained landscapes and are considered moderately agriculturally productive. Sardinia's Luvisols are distributed in patches throughout the island, with a particular concentration in the area around Cagliari. Sardinia's Leptosols are concentrated in the north and central parts of the island, though they make up much of the soils found on the small islands of Sant' Antioco and San Pietro off Sardinia's southwest coast. Leptosols are shallow soils that develop over hard rock and include very gravelly or highly calcareous material. They are generally found in mountainous regions and in areas where the soil has been heavily eroded so that bedrock is very near the ground's surface. Leptosols generally have poor soils structure, which combined with their shallowness makes them poor areas for agriculture.

Umbric Andosols form the only other large group of soils on Sardinia. A concentration of Andosols is found around Macomer, with smaller patches in the central part of the island and along the southwest coast. Andosols are young soils that develop on highly weatherable volcanic deposits and are considered moderately fertile.

The remaining soil types, present in small quantities, are Eutri-gleyic Fluvisols, Chromic Vertisols, and Calcaric Regosols. Fluvisols are young soils that develop on

alluvial, lacustrine, or marine sediments and can be very agriculturally productive. The Fluvisols on Sardinia are present in their greatest quantities around the Gulf of Oristano, where the large Tirso River and three smaller rivers flow into the Mediterranean. They are also present in smaller quantities in pockets along the north and southwest coasts, where smaller rivers have influenced soil formation and deposition. The Vertisols, which are seasonally shrinking and expanding soils that contain high percentages of swelling clays, are found in patches in a band running from the area around Oristano to Cagliari. Vertisols are considered to have high agricultural productivity. Finally, Regosols are weakly developed mineral soils with thin horizons and little structure. They are extensive in eroding lands and rock outcrops occur commonly within areas of Regosols. Regosols are considered to have moderate agricultural productivity. Sardinia's Regosols are found in scattered locations, with concentrations on Sant' Antioco and San Pietro.

Based on soil types and their distributions, Sardinia has a high general level of agricultural productivity. This productivity is concentrated in the area stretching from Oristano to Cagliari, an area encompassed by the modern regions of Oristano, Medio Campidano, and Cagliari. This fertile stretch includes most of the island's highest-productivity soils: the Fluvisols, Vertisols, Andosols, and Luvisols. It is hardly surprising that this area of Sardinia is still considered the breadbasket of the island and produces most of its cereals.

However, the agricultural productivity of the rest of the island, predominantly Cambisols with patches of Luvisols, is also fairly high. Cambisols can be quite agriculturally productive, which suggests that low soil productivity was unlikely to have been a limiting factor affecting prehistoric settlement in and of itself. Only the areas of Leptosols, associated with Sardinia's more mountainous regions, could have presented serious difficulties for agriculture, and alternative subsistence strategies such as a greater reliance on gathered woodland foods or more extensive use of animal husbandry were available as options for adaptation to these areas.

The Siddi Plateau is located near the northeastern border of the Medio Campidano region, one of the generally very fertile regions of Sardinia. However, the Siddi Plateau lies outside the main area of extremely high fertility. The plateau itself is a rock outcropping with only thinly-developed soils: Euteric and Lithic Leptosols. This means

that the plateau is not particularly fertile, a fact which is reflected in its current uses: it is used primarily for pastoralism and apiculture with little attempt to farm it. The soils immediately surrounding the Siddi Plateau are primarily Calcaric Regosols with Calcaric Cambisols nearby and some patches of Calcic Vertisols farther away (see Image 3).

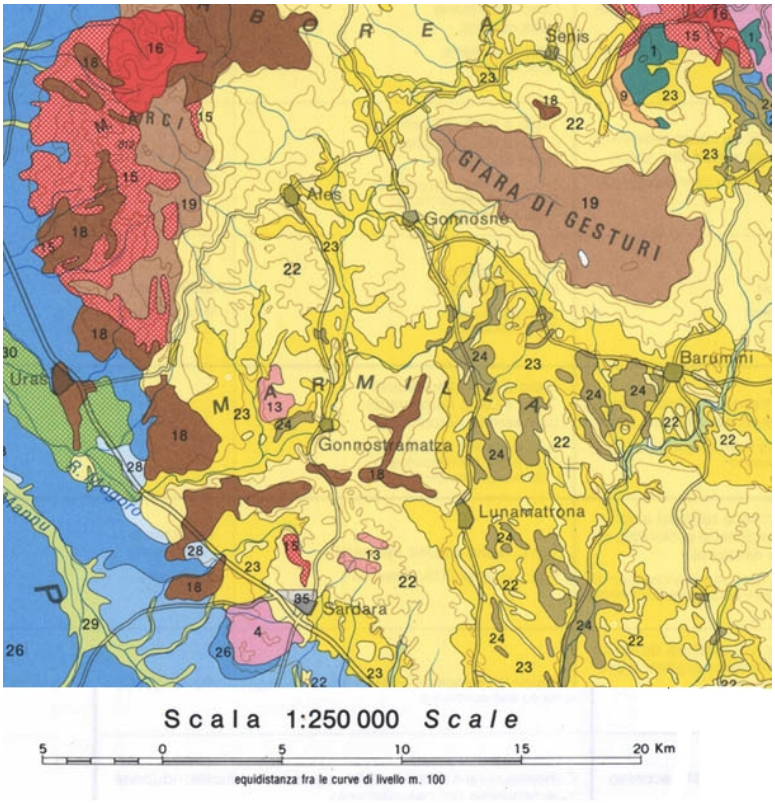


Image 3: Soil types around the Siddi Plateau.18 = Rock outcrop with Euteric and Lithic Leptosols. 22 = Euteric and Lithic Leptosols with Calcaric Regosols. 23 = Calcaric and Vertic Cambisols. 24 = Eutric and Calcic Vertisols. 13 = Rock outcrop with Euteric and Lithic Leptosols. From Aru et al. 1990.

Regosols have moderate agricultural productivity, and Cambisols and Vertisols can be quite productive, making the area around the Siddi Plateau a fairly productive agricultural region. These soils are currently used for grain agriculture, olive and almond orchards, viticulture, and some fruit trees. Judged by the current distribution of soils, the ancient inhabitants of the Siddi Plateau would have had to farm in the lowlands around the plateau to achieve moderate levels of agricultural productivity, and they would have had to travel farther to have access to highly productive soils, but they would not have had to

go far.

The question remains, to what extent can we use contemporary soil patterns to reconstruct ancient ones. For Sardinia, the correlation between ancient and modern soil patterns is probably strong at the macro-level. Although Sardinia is subject to strong winds and seasonal rains, Sardinia's climatic regime allows for the development of substantial ground cover. As long as this ground cover was present, it is unlikely that substantial amounts of soil were moved through the mechanical processes of erosion. Additionally, soils can take thousands of years to form, allowing pedologists to identify areas where ancient soils have been stripped or moved and the process of soil formation has started over again. Finally, the historical and current underdevelopment of Sardinia's infrastructure - roads, urban areas, housing developments, etc. - makes it unlikely that large amounts of soil have been moved through human action. At the macro-level, soil movement since prehistory has probably been small.

It is important to stay aware of potential soil movements at the micro-level, however. Areas which may have lost their ground cover in the past would have experienced erosion, and deposits of Fluvisols have likely grown in size over the centuries as more sediment has been washed into them. It is also likely that the percentage of Sardinia covered by Regosols has grown over the centuries as erosion has become an increasing problem. This is particularly relevant for reconstructing the soils around the Siddi Plateau. The Siddi Plateau is located in an area of Sardinia currently rated as having a moderate to high level of erodability (3-4; see Image 4). This suggests that the Regosols that develop around the plateau may have a greater distribution now than they did in the Bronze Age, when greater amounts of ground cover may have kept these soils in place.

Almost all of the island of Sardinia is rated as having an erodibility between 3 and 5, with 5 being the highest level of erodibility. Although the majority of Sardinia's soils are moderately-to-highly agriculturally productive, some of them are relatively thin (Leptosols and Regosols), and because of Sardinia's topography, many of them occur on areas with a potentially problematic degree of slope. Ground cover is necessary to hold these soils in place, and destruction of the ground cover, whether through extensive agriculture or overgrazing, could have resulted in locally catastrophic soil losses. This

high general susceptibility of Sardinia to erosion means that erosion was probably the biggest soil-related danger for prehistoric Sardinians. Soil depletion, particularly of thin soils, may also have posed a potential problem. If agriculture was practiced extensively with little effort to replenish the soils, a decrease in local soil productivity could have occurred.

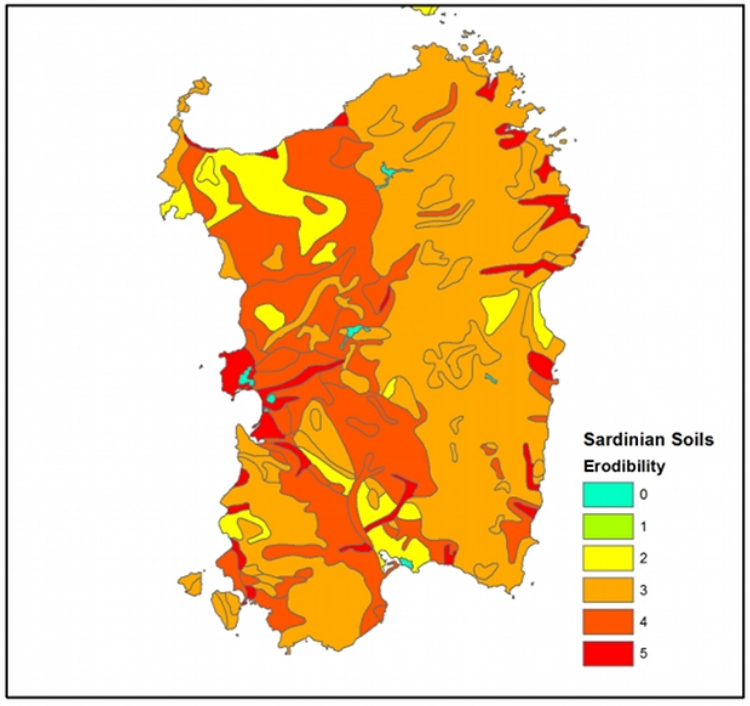


Image 4: Erodibility of Sardinian soils. The area around the Siddi Plateau is rated 3-4.

Raw Materials

Sardinia's heterogenous geology provides a wide variety of raw materials and mineral resources. Clay is abundant throughout the island, and prehistoric Sardinians had access to several types of good building stone, obsidian and other flakeable stone, and metal ores. These resources are distributed differentially across the island, however, making their location, ease of access, and ease of transport of potential relevance when reconstructing the economic practices of particular ancient groups.

The Siddi Plateau rises 250 m in elevation above the surrounding valley floors,

often rising part of the way gradually before hitting a sheer face. Even in areas with no sheer cliffs, the 250 m change in elevation occurs in a span of about 50-100 m, making access to the Siddi Plateau quite difficult. Visibility over the lowlands from the top of the Plateau is excellent, at least in the current period when the lowlands have been completely deforested, a situation that cannot be assumed for the Middle Bronze Age. Even with possible forest cover, however, the height of the plateau gives an advantage in visibility, which, combined with the difficult access, makes the Siddi Plateau a highly defensible location.

Building stone

The strongest building stones on Sardinia are basalt and granite. They were used extensively in prehistory in the construction of the island's megalithic monuments as well as for ceremonial statuary (see the discussion on statue-menhirs in the following chapter), and they continued to be used in local constructions throughout the later Punic, Roman, Medieval, and Early Modern/Modern periods.

Basalts have a fairly limited distribution on the island, being found in the region around Monte Ferru north of the fluvial plains surrounding the Gulf of Oristano, scattered throughout the region of the Marmilla, and just north of the Gulf of Orosei on the east coast. Granite is more common, as granite is the foundation of the Sardo-Corsican massif and is exposed in about 6000 km² of the island (Puccini et al. 2010). Granites make up the mountains of the Gennargentu and north as well as the Iglesiente, though the long geological periods over which these granites were deposited makes for important differences in their mineral composition (Puccini et al. 2010).

Other stones were also used for building on Sardinia, though they are often more susceptible to weathering than granite or basalt. Limestone is found throughout Sardinia and was used both for building and for rock-cut tombs. The Romans made extensive use of the limestone around Cagliari, using it to construct the amphitheater and other buildings as well as mining it for lime. Limestone remained one of the most important building stones in the Cagliari area through the Early Modern Period. Tuffs are also important building stones on Sardinia. They occur mainly in the north and northwest of the island.

Finally, very soft stones such as sandstones and mudstones are occasionally used for construction, though they do not weather well. The use of less-than-ideal building stone is particularly common for prehistoric constructions where availability and ease of transport may often have been of greater concern than the strength of the stone itself and the likely longevity of the building. The nuraghe of Genna Maria is a good example of this problem. Built out of blocks of local Miocene mudstones, extensive conservation work has been necessary to prevent it from crumbling under its own weight (M. Perra, pers. comm.).

The Siddi Plateau and other plateaus in the region were formed when flows of basalt from the then-active volcano Monte Arci settled in low-lying pockets of Mesozoic sea beds. The hard basalt prevented the softer mudstone beneath from eroding, and over time the higher grounds surrounding the pockets of basalt were worn away, turning the once low-lying sea beds into mudstone plateaus capped by layers of basalt. These plateaus proved attractive areas for Middle Bronze Age settlement, probably at least in part for their defensibility and good viewsheds, but also for their easy abundance of good building stone. The corridor nuraghi and giant's tomb on the Siddi Plateau were all built of local basalts, sometimes quarried from their immediate building sites (see discussion in Chapter 8, Image 26).

The most immediate resource found on the Siddi Plateau, and likely part of the reason for the plateau's selection as a major site of Middle Bronze Age settlement, is the easily available high-quality basalt building stone. Studies have shown that the local availability of good building stone was a major factor in the selection of site locations for corridor nuraghi (Manca Demurtas and Demurtas 1992:176). The basalt weathers into irregular blocks, and the corridor nuraghi on the Siddi Plateau are built primarily of these naturally-occurring blocks, with very few blocks showing any sign of intentional shaping. The convenience and easy access of this resource was undoubtedly a strong incentive for settlement on the plateau.

Obsidian and other flakeable stone

Sardinia is one of only a few obsidian sources in the Mediterranean. The island of

Melos in the eastern Mediterranean and the islands of Lipari, Pantelleria, and Palmarolla in the western Mediterranean are the only other sources. Sardinian obsidian comes from Monte Arci, an extinct volcano in the west-central part of the island near Oristano. Sardinia's obsidian formed an important resource for early settlement of the island and was exported from the island as early as the first Neolithic settlement there. The Siddi Plateau lies roughly 15 km southeast of Monte Arci, making obsidian procurement an easy task to accomplish in a short, 2-3 day trip. It is possible that obsidian procurement was complicated by the presence of other groups who may have controlled the stone, but the proximity of the source may still have acted as a strong incentive for settlement on the Siddi Plateau.

Although noteworthy for its rarity and generally preferred because of its fine flaking qualities, obsidian is not the only flakeable stone on Sardinia. Flint is another flakeable stone found in outcroppings on the island. It is located primarily in the north and was used throughout prehistory, though with changing intensity. Additional stone resources, including flakeable and attractive green chalcedony, are available at a slightly greater distance from Monte Grighine, 26 km to the north of the Siddi Plateau.

Metal ores

Sardinia's mountains are rich in a variety of metal ores, of which copper and tin are the most significant for Mediterranean prehistory (see Image 5). Copper ores are found throughout the island, with concentrations in the mountains of the Iglesiente in the southwest of the island, the mountains of the Gennargentu in the central-east, in the mountains of the Màrghine, Gocèano, and Alà that stretch in a diagonal band from north of the Gulf of Oristano on the west coast toward the Gulf of Olbia on the northeast coast, and in Monte Alba north of the Gulf of Orosei. However, smaller pockets of copper ore are found wherever there are mountains, including the area of La Nurra north of the Gulf of Alghero, the Anglona and Logudoro south of Castelsardo in the north, in the central Gallura in the northeast, and in the area of the Gerrei in the southeast. The ubiquity of copper sources across the island provided constant opportunities for the discovery and development of this resource in Sardinian prehistory, and the high concentrations of copper ores gave Sardinia great potential economic significance as metals gained in

importance throughout the Mediterranean during the Eneolithic and Bronze Age.

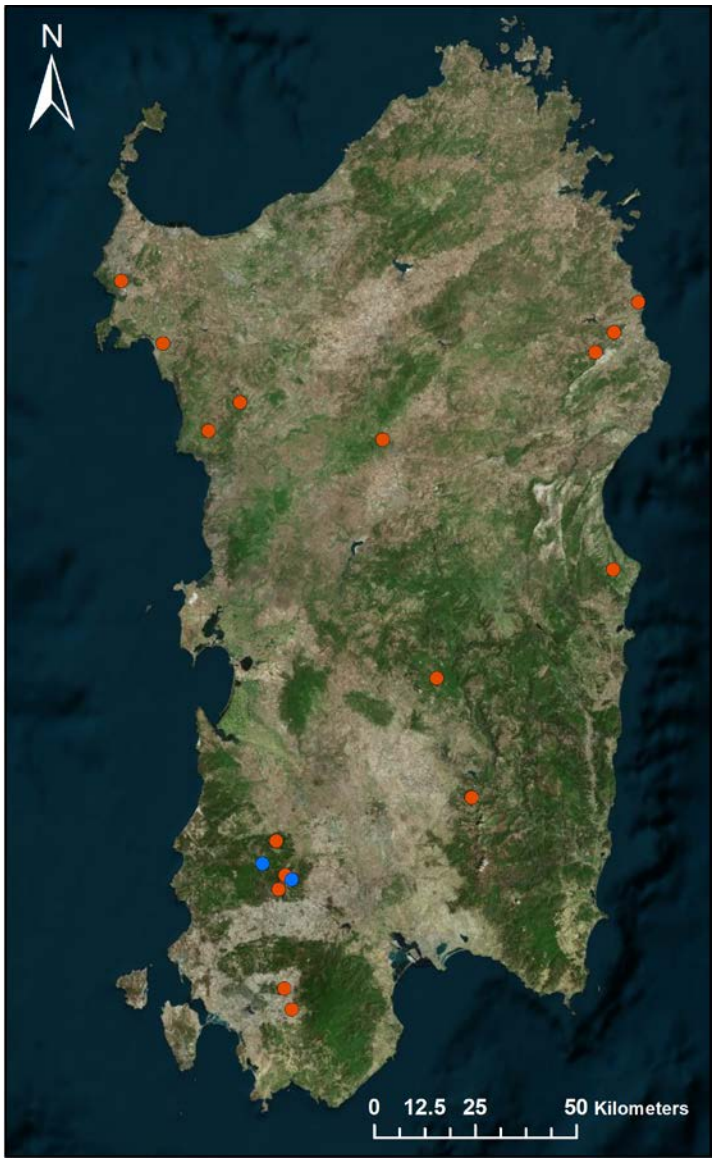


Image 5: Major sources of metal ores on Sardinia. Orange dots represent copper ores, blue dots represent tin ores. After Webster 1996: 36.

Tin ores are also present in Sardinia, though in much smaller concentrations. These tin ores are concentrated in the Iglesiente and are found almost nowhere else on the island, making access to them much more limited. Unlike the copper ores, many of which show clear signs of having been mined at least as early as the Roman period (Rowland 1988), it is uncertain whether the ancient Sardinians were aware of the tin ores and

exploited them. However, given that exploitation of copper resources began as early as the Neolithic and that extensive exploitation of copper ores was underway by the Middle Bronze Age, and also considering the proximity of the tin ores to numerous sources of copper ores, it seems likely that exploitation of tin ores also occurred in prehistory.

Iron ores are common on Sardinia, and iron was probably first produced as a byproduct of smelting Sardinian copper ores (Becker 1984:190). Prehistoric experiments with iron began as early as the Late/Final Bronze Age and Early Iron Age, as shown by the find of an iron bracelet in the giants' tomb in Bidistili (Fonni-NU) and the incorporation of iron elements into bronze objects such as pins, basins, and small sculptures (Lo Schiavo 1986:245). However, the use of iron did not become common until later in the Iron Age.

Finally, some sources of silver are found scattered throughout Sardinia; however, the use of this metal does not seem to have gained much popularity in Sardinia's prehistory. The occasional silver object is found in Eneolithic burial contexts (Lo Schiavo 1986:232, 235), but silver artifacts are not known from other prehistoric contexts and become common only during the later Iron Age, when Sardinia is influenced by contact with the Phoenician, Carthaginian, and Roman cultures.

The Siddi Plateau is located just over 30 km north-northwest of a concentration of both copper and tin ores in the Iglesiente mountains. The Siddi Plateau is also located roughly in the center of a semi-circle of copper ore sources, which occur at distances of 30, 34, and 28 km to the southwest, southeast, and northeast of the plateau.

HYDROLOGY

The hydrology of Sardinia is very poorly developed. The general aridity of the region leads to the infrequent recharging of its aquifers, and severe droughts occur about once every four years, twice the average for the Mediterranean Basin in general. While there are many streams and small rivers that flow during the rainy season, almost all of these evaporate during the summer (Webster 1996:31), leaving the majority of the island dry, brown, and arid. Only the most major rivers flow year-round (Image 6), including the Cedrino, the Flumendosa, the Mannu, the Tirso, and the Coghinas. All of these rivers

have their origins in the springs of the mountainous Barbagia region on the east side of the island, flowing to different points on the east, south, west, and north coast from there. While the areas immediately surrounding these rivers certainly benefit from the water they provide, the rivers do little to combat drought at greater distances in the absence of systems of irrigation.

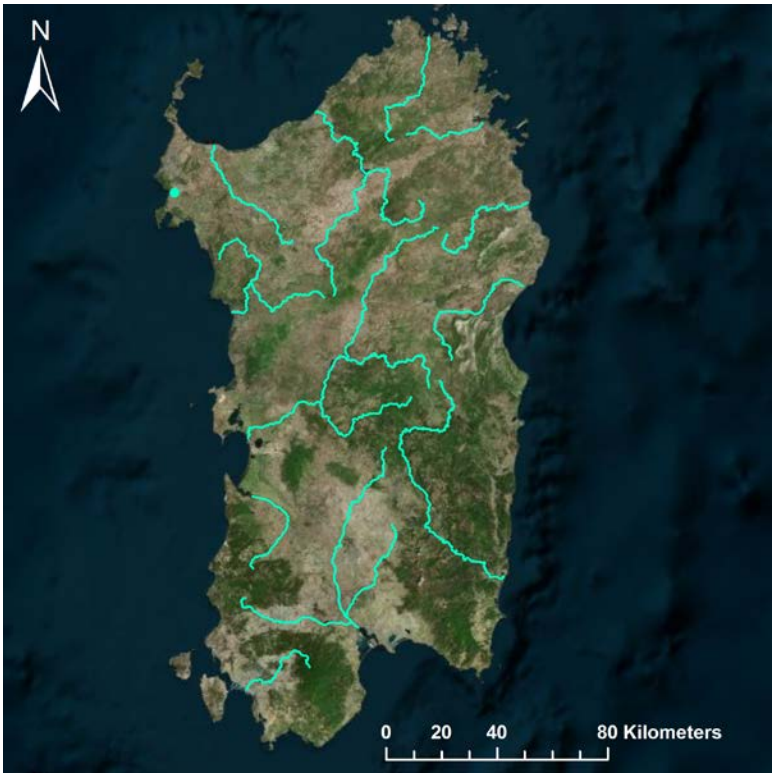


Image 6: Major rivers of Sardinia with Lake Baratz indicated (dot).

Although efforts to improve Sardinia's water supply have lead to the damming of all major and several minor rivers to create numerous artificial lakes, there is only one natural lake on Sardinia. This is Lake Baratz in the northwest of the island, about 16 km northwest of the modern city of Alghero and only 2 km inland from the nearest coast. Lake Baratz is quite small, only about 0.6 km² in total surface area. Again, while it may have provided good resources for prehistoric people in its immediate vicinity, only the development of an irrigation system could have carried those advantages any great distance.

In general, the largest amount of reliable fresh water in prehistoric Sardinia would

have been found near the coasts, at the mouths of the largest rivers and at Lake Baratz. The coasts provided other aquatic resources as well. Though not useful for drinking or irrigation, numerous brackish lagoons line the west and south coasts of Sardinia, with particularly large examples at Cabras on the central-west coast and Santa Caterina and Cagliari in the south. These lagoons are full of fish and shellfish, and they also attract large numbers of water birds. The combination of fresh water sources and the abundant resources of the lagoons made coastal areas attractive places to settle.

Settlement could have crept inland from the fertile coasts along the routes of the major rivers; however, the problem of inland settlement at a distance from the rivers had to be addressed through another source of fresh water: springs. Small springs are found throughout Sardinia. They are often so small as to be easy to miss in the landscape: where they haven't been improved, they appear only as spots of brighter green amidst the dark green of the Mediterranean maquis. Although the springs tend to be quite small, they are numerous, and they almost certainly formed the key to inland settlement.

As in much of Sardinia, the hydrology of the Siddi Plateau is underdeveloped (Image 7). There is only one small spring, located on the east side of the plateau near one of the nuraghi. Although this spring is small, the current inhabitants of the town of Siddi claim that it never runs dry, and it probably served as the primary source of water for many of the ancient inhabitants of the plateau.

There is no other securely identified spring on the plateau. However, another water feature has been identified, possibly a spring but also possibly a water collection pit carved into the basalt bedrock of the plateau. Locals were unable to comment in detail about this feature, but in three seasons of excavation at the site, it was never observed without water in it. A superstructure has been built over the water feature, potentially indicating that it is part of the Middle Bronze Age built environment. It will be discussed in greater detail below.

Drainage on top of the plateau is very poor due to the layer of impermeable basalt below the shallow soil. This leads to an unusual landscape, often cracked and very dry during the hot summers, but marshy during the wet winters and springs, supporting the growth of water-loving plants in addition to the more usual Mediterranean maquis. The high water retention of the soil makes agriculture somewhat difficult and, though some

farmers do plant fields on top of the plateau, the area is much preferred for grazing sheep, goats, and cattle, for raising bees, and for gathering wild foods, an activity that is still much practiced by the locals.

Image 7: Hydrology near the Siddi Plateau. Lines represent small, seasonal streams. Dots represent the spring on the east side of the plateau and the water feature in the north of the plateau.

There are no perennial rivers or streams in the immediate lowlands of Siddi Plateau, though in the wet season small streams do develop temporarily. The largest is located about 3 km to the northwest of the plateau, and could have served seasonally as a source of water for consumption or possibly irrigation, as well as a source of water-loving plant resources.

Finally, the lagoons of Oristano lie 26 km to the west of the Siddi Plateau. These lagoons were the location of very large Neolithic and Eneolithic settlements, and the resources they provided - including edible shellfish - may have remained of interest to the Nuragic inhabitants of the Siddi Plateau.

CLIMATE AND ENVIRONMENT: CURRENT CONDITIONS

The current climate of Sardinia is typically Mediterranean, with cool, wet winters and hot, dry summers. Average temperature fluctuates between 5°C and 18°C in the winter months and 15°C and 29°C in the summer months. Minimum average monthly rainfall is 3 mm in the south and 8 mm in the north, while maximum monthly average rainfall is 57 mm in the south and 104 mm in the north. Average yearly precipitation at sea level is around 427 mm in the south and 610 mm in the north (Average Weather in Alghero, Sardinia 2010; Average Weather in Cagliari, Sardinia 2010), while in the uplands it averages 600-800 mm and in the mountains 900-1200 mm (Webster 1996:37–40). In general, July is the hottest and driest month throughout the island, while the coolest month is January. The wettest month varies in different geographical areas. Finally, Sardinia lies in an area of almost constant low pressure, which causes it to be swept by winds, some of which can reach up to 120 km/h (Massoli-Novelli 1986:4).

Sardinia's vegetation reflects this climatic regime coupled with the diverse elevations found on the island: vegetation is primarily Mediterranean maquis with evergreen and deciduous forest in the more mountainous areas. The maquis of the plains and hills consists mainly of juniper, gorse, myrtle, wild olive, holm oak, lentisk, wild rose, privet, and laurels, with cork oak also being cultivated in this area for its bark. Forest, which in the 18th and 19th centuries covered much of the island according to travelers' accounts (Massoli-Novelli 1986:4), now covers only about 5% of the island and consists mainly of red, holm, and cork oak, as well as holly, elder, olive, elm, and hawthorne (Webster 1996:31).

The contemporary terrestrial fauna now found on Sardinia are exclusively introduced; both wild and domestic animals were brought to the island by human settlers. Although some of the introduced domestic animals escaped and formed feral subspecies, no truly indigenous species are known to exist on the island (Schüle 1993:408). The latest-surviving indigenous land animal, a hare-like rodent called the *Prolagus sardus*, existed on the island at least as late as the Early Iron Age, when it still formed a noticeable part of the diet. Although it is uncertain exactly when the last *Prolagus sardus* disappeared, the animal is now agreed to be extinct.

The history of animal extinctions on Sardinia is hypothesized to be connected to

waves of human use of the island (Schüle 1993), though not all scholars agree with this reconstruction. The megafauna of the Pleistocene were hunted to extinction by bands of *Homo erectus* living on or utilizing the island, for whom there is increasing - though not undisputed - archaeological evidence (see Chapter 6). The island was then colonized by *Megaloceros* sp., which were again hunted to extinction with the arrival of Upper Palaeolithic *Homo sapiens*, for whom the archaeological evidence is secure. The only indigenous Sardinian carnivore, the dog-sized *Cynotherium sardous* became extinct along with its *Megaloceros* prey, leaving *Prolagus sardus* as the only indigenous terrestrial animal on the island.

The extinction of all large terrestrial species, as well as all indigenous predators, left Sardinia an easy environment for human-aided animal colonizations which accompanied increased human occupation. Wild animals such as red and roe deer, wild boar, fox, wild cat, and rabbit were brought to the island and released, presumably as game to be hunted. Domestic cattle pigs, sheep, and goats - and later horses and other equids - were also brought to the island as part of animal husbandry practices, though some escaped and formed feral subspecies. The mouflon, Sardinia's "wild" sheep, was already common on the island in the Roman period and is mentioned in the writings of Pliny (8.74.199) and Strabo (5.2.7) (Webster 1996:31). The dwarf horse, another feral subspecies that probably postdates the mouflon due to the late introduction of horses to Sardinia, can still be seen roaming free on the Gesturi Plateau.

CLIMATE AND ENVIRONMENT IN THE MEDITERRANEAN HOLOCENE

The current climatic regime on Sardinia cannot be assumed simplistically to resemble the climatic regime of the island's prehistory. Understanding past events requires reconstructing, to the best of our ability, the changing climate and environment that prehistoric Sardinians would have experienced. Unfortunately, there is limited climate and environmental data available for prehistoric Sardinia. Only a handful of pollen studies using excavated pollens address environment in the Neolithic and Bronze Age, and I know of no speleothem, sedimentation, or lake level studies. An attempt will therefore be made here to combine the evidence for climate and environment in the

Mediterranean in general (see Image 8) with what evidence is available for Sardinia itself. The study period will start at the beginning of the Holocene and continue through the beginning of the first millennium BCE. This period covers the entire prehistory of Sardinia, from its Neolithic settlement to the early colonization efforts of literate East Mediterranean groups.

Data less likely to be influenced by human activity, such as speleothems, fluvial activity, and lake level, will be used preferentially to reconstruct climate. Pollens will be used with caution in climate reconstructions, particularly for the Neolithic and later, since they are more prone to be influenced by human activity and natural occurrences such as forest fires. In general, pollens will be used primarily as an indication of environment rather than climate.

Climate Change

Due to the lack of climate data for Sardinia specifically, Holocene climate change will first be discussed for the Mediterranean in general, and key issues for understanding Mediterranean climate change will be identified. Next, an attempt will be made to understand climate change on Sardinia by using climate data collected from other locations in Italy as proxy data for what was likely to be happening on Sardinia. Although the method of using data from other areas to understand Holocene climate change in Sardinia is inherently likely to contain inaccuracies, it is the best that can currently be accomplished with the available data.

Both the Mediterranean-wide and the Sardinia-specific reconstructions will attempt to identify two types of climate change. First, the study will attempt to reconstruct gradual climate change. Humans are able to adapt to slow changes in climate that occur over periods longer than a couple of centuries. Gradual changes in settlement patterns and subsistence practices are two responses to slow climate change that are readily visible archaeologically. Second, the study will attempt to identify multicentennial-, centennial-, multidecadal-, and decadal-scale fluctuations particularly as they apply to the period with which this study is primarily concerned: the Eneolithic and Bronze Age. Severe changes in climate that occur over periods shorter than two centuries have been identified as being the types of changes most likely to have a disruptive effect

on human cultures (Büntgen et al. 2011; deMenocal 2001; Haug et al. 2003; Weiss and Bradley 2001). Understanding whether climate fluctuations at these scales occurred during the period under study will be an important part of evaluating the relationship between environmental factors and the development of Nuragic social complexity.

Image 8: Climate and environment studies referenced in the text. (1) OPD Leg 161 Site 976. (2) Corchia Cave. (3) Lake Frassino. (4) Lake Accessa. (5) Ombronoe River Delta. (6) Core MD 04-2797 CQ. (7) Lake Mezzano. (8) Lake Preola. (9) Lake Albano. (10) Lake Fucino. (11) BS 7937, BS7938. (12) Lake Pergusa. (13) KET 8003. (14) Gulf of Salerno. (15) Lago Grande di Monticchio. (16) SL 152.

Mediterranean climate change

Latitude rather than longitude has emerged as the important dividing feature in understanding Mediterranean climate change in the Holocene. Mediterranean lake level

records from above and below 40°N show opposite patterns of climate change (Magny et al. 2011; Roberts et al. 2008). At the millennial scale, climate north of 40°N seems to have been drier in the early Holocene with maximal lake level lowstands ca. 9200-7700 cal BP (Magny et al. 2007). Climate then slowly shifted to wetter conditions. South of 40°N, climate seems to have been generally wetter in the early Holocene, with lake level maxima ca. 9000-8200 cal BP at Lake Pergusa (Sadori and Narcisi 2001) and ca. 10,300-4500 cal BP (though with considerable multi-centennial and centennial-scale fluctuation) at Lake Preola (Magny et al. 2011), after which climate slowly shifted to drier conditions (Issar 2007; Roberts et al. 2011). In the Near East, fully developed aridity occurred by 4600 cal BP (Finné et al. 2011).

These opposite north-south patterns are sometimes identified or expressed as an east-west climate divide (Roberts et al. 2011); however, this can be understood as an effect of Mediterranean geography. Most of the East Mediterranean is south of 40°N, while much of the West Mediterranean is north of 40°N (Roberts et al. 2008; Roberts et al. 2011:11). Finally, it is important to note that the opposite climatic regimes identified using lake level fluctuations have recently been questioned on the basis of palaeoclimate reconstructions using pollens from lake cores (Peyron et al. 2011); this study concludes that a general pattern of a wetter Holocene becoming drier obtains for the entire Mediterranean (Dormoy et al. 2009), and that apparent discrepancies are caused by a failure to allow for how changes in the seasonality of precipitation affect different types of proxy data.

Although understanding millennial-scale climate change can help elucidate long-term trajectories in settlement patterns and subsistence strategies, multicentennial- to multidecadal- (deMenocal 2001; Weiss and Bradley 2001) and decadal-scale changes (Büntgen et al. 2011; Haug et al. 2003) are thought to be more important in influencing human cultural events. In the West Mediterranean, lake-level fluctuations at lago dell'Accesa in Tuscany, Italy (Magny et al. 2007) show numerous centennial-scale fluctuations. Against the background of an increasingly wetter climate, individual short-lived highstands occurred ca. 11,500, 11,100, 10,200, 9400, 8200, 7300, 6200, 5700-5200, 4850, 4200, 3400, 2600, 1200 and 400 cal BP; these highstands have correlates in lake levels at Lake Mezzano and Lake Fucino (Magny et al. 2007:1756), also north of

40°N.

In relationship to the period of most interest to this study, 6000-900 BCE, the evidence from lakes north of 40°N would indicate brief, unusually wet episodes occurring ca. 5350, 4250, 3750-3250, 2900, 2250, and 1450 BCE. Two of these highstands occurred against a background of lower lake levels that started as early as 3700 BCE and lasted until about 2350 BCE (Magny et al. 2007:1750–1751). Such brief, pronounced fluctuations in climate are the most likely to have had distinct disruptive effects on human activities.

Lake Preola in Sicily, which lies south of 40°N, also shows considerable centennial-scale change. In particular, the periods between 10,300-9000 cal BP and 6400-4500 cal BP seem to be transitional periods, and are characterized by frequent, high-amplitude lake level fluctuations (Magny et al. 2011). In terms of this study, these results would indicate that the period 4450-2550 BCE was climatically volatile. The period 2550-2050 may also have been experienced as a centennial-scale event, due to the rapidity of the climatic drying that took place during these 500 years. In the Near East, which lies predominantly south of 40°N, a centennial-scale drying event occurred ca. 4050 BCE, which was followed by a return to wetter conditions for about 500 years, and then a continuation of the drying trend followed by another series of oscillations between 1500-1000 BCE (Issar 2007:813–814).

Temperature for the Mediterranean seems to have been fairly stable for most of the Holocene, indicating that much of the observed climatic fluctuation, particularly for the later Holocene, was due to factors other than shifts in temperature. After the Younger Dryas (11-10 ka cal BP), Mediterranean temperatures become warmer, reaching their warmest around 9-6 ka cal BP. Brief cooling events occurred at 9.2, 8.2, and between 7-6.5 ka cal BP. A fourth cooling event occurred at ca. 2 ka cal BP, though this final event falls outside the scope of the current study. With the exception of these cooling events, Holocene temperatures in the Mediterranean remained stable and warm (Rouis-Zargouni et al. 2010).

The recorded temperature changes have close correlates in lake level highstands north of 40°N occurring at 9.4, 8.2, as well as possible correlates with highstands occurring around 7.3 and 6.2 ka cal BP. However, numerous highstands occurring both

before and after the Holocene temperature fluctuations are clearly unrelated to temperature change. Lake levels south of 40°N show very little correlation with temperature change, with the exception that high levels of fluctuation occur between 10.3-9 ka cal BP, as the Mediterranean was warming to its Holocene levels, and at 6.4-4.5 ka cal BP, as the Mediterranean was warming out of a brief cold period. While the evidence indicates a relationship between temperature and climatic fluctuation, it is clear that temperature was not the only force driving Holocene climate changes in the Mediterranean.

Proxy data from sources at Sardinian latitudes

Understanding Holocene climate change on Sardinia provides a particular challenge due to Sardinia's geographical location. The 40°N latitude line almost perfectly bisects Sardinia, suggesting that it would be inadvisable to apply either the northern or southern Mediterranean climate trend to reconstruct climate change on the island without further confirmation that one or the other of these patterns more accurately reflects the changes around 40°N. Although the trends discussed above appear valid for the South (East) and North (West) Mediterranean generally, reconstructing Sardinia's climate will require the examination of proxy data from sources that share Sardinia's intermediate geographic location. Given that all but a very small percentage of the island of Sardinia falls between 39°0'N and 41°15'N, climate studies on samples located between these latitudes will be considered good indicators for Sardinia for the purposes of this study. Climate studies that fall within 30' outside of these latitudes will be considered moderately good indicators for the purposes of this study (see Image 9).

One of the few climate studies undertaken for mainland Italy at a Sardinian latitude is a study of a marine core taken from the Gulf of Salerno, roughly 400 km to the east of Sardinia on the west coast of the Italian mainland in the region of Campania. Located at 40°42'24''E, this core falls almost precisely on the identified climate boundary and slightly to the north of center with respect to Sardinia. The results from several sediment studies undertaken on the marine core indicate that the area experienced increasing rainfall in the Holocene, from 9500-6000 BP (Naimo et al. 2005). This pattern reflects the general pattern identified for the Mediterranean north of 40°N, and we might

therefore expect that Sardinia would share this pattern.

Another marine core taken near 40°N latitude (40°19'N, 24°36'E) and analyzed using a multi-proxy approach shows an opposite pattern. This core, SL 152, indicates a climate optimum in the early Holocene ending ca. 7.8 ky cal. BP, after which climate became increasingly arid and slightly warmer (Dormoy et al. 2009). SL 152 comes from the basin of Mt. Athos in the Aegean Sea, about 14° east of Sardinia, and it could be argued that a different Holocene climate obtained at the more eastern Mediterranean longitude where this core was taken; however, a second marine core used in the same study taken from a much more western longitude (OPD Leg 161 Site 976; 36°12'N, 4°18'W) shows the same pattern of increasing aridity and temperature during the later Holocene. It is important to note that SL 152 is barely north of 40°N and OPD Leg 161 Site 976 is below 40°N, suggesting that both cores may be expected to reflect the southern Mediterranean climate pattern identified by some researchers. However, centennial-scale cool and dry events identified in both marine cores match well with lake level fluctuations observed in the sediments of Lake Accessa (Dormoy et al. 2009:626–627), which is north of 40°N. This suggests that climate forcing events were linked throughout the Mediterranean, although they may not have had similar local or regional effects.

Multi-proxy studies from Lake Albano in central Italy, which is only 30 minutes north of Sardinia's northernmost point, agree with the evidence from the Gulf of Salerno. Increased sedimentation rates are identified for the late Holocene, indicating greater erosion taking place at this time (Ariztegui et al. 2001; Lami et al. 1997). However, the authors do not link greater erosion directly with increased rainfall, and instead suggest human disturbance of the lake's catchment (Lami et al. 1997) or general, world-wide changes in moisture balance (Ariztegui et al. 2001). These studies highlight an important point in reconstructing climate change from sedimentation rates: increased rainfall is not the only potential cause of increased sedimentation rates.

Image 9: Climate studies used as proxies for Sardinia.Darker blue dots fall within Sardinia latitudes. Lighter blue dots fall just outside Sardinian latitudes. Left to right, the studies are: Lake Albano; BS 7937, BS7938; KET 8003; Gulf of Salerno; Lago Grande di Monticchio; SL 152.

It is difficult to create a unified picture of climate change at Sardinian latitudes from the available research, and no consensus has yet been reached in the scholarly community. It seems safe to say only that centennial-scale climate changes probably occurred at roughly the same times as they did north and south of Sardinia, with volatility concentrated ca. 4300-2000 BCE. It also seems safe to say that Sardinian latitudes experienced general, progressive climate changes that led to increasing sedimentation during the late Holocene, but whether this was due to increased rainfall or other landscape disturbance is difficult to say.

Environmental change

As in the section on climate change, environmental change will be evaluated both from a general, Mediterranean-wide perspective and from a specifically Sardinian perspective. As with climate, the amount of environmental data that specifically targets Sardinia is limited. Only two pollen studies directly address the palaeoenvironment of Sardinia. Biogeographical studies have addressed the particular development of environment on Sardinia, and will help with the reconstruction.

Unlike with climate reconstruction, there is little value in attempting to reconstruct the specifically Sardinian environment from proxy data available from sites at similar latitudes. While climate change takes place across large geographical extents, local environmental responses to climatic events are highly variable (Jalut et al. 2009:10). Even if Sardinia was being influenced by the same climate changes experienced by mainland Italy, there is no guarantee that Sardinia's local environments would have responded in the same ways. Environmental change at specifically Sardinian latitudes will be addressed as part of the discussion on Mediterranean trends in general, but is intended only to contextualize the small amount of data from Sardinia itself; it is not assumed that environmental change on Sardinia and at Sardinian latitudes was necessarily similar. As a result, the environmental reconstruction for Sardinia presented here will be quite limited. More work needs to be done, both for the island generally and for specific areas of human activity, before scholars can begin to relate Sardinian environmental change and human behavior with confidence.

Mediterranean environmental change

Palynological studies of the Mediterranean Holocene generally agree that the "mediterraneanization" of the environment, meaning the transition to drought-tolerant plant taxa, took place progressively beginning around 8000 yr BP (Jalut et al. 2000; Sadori, Jahns, and Peyron 2011). Within this progressive environmental change, specific aridification events that favored evergreen sclerophyllous taxa over deciduous broad-leaf taxa took place between 8400–7600 cal BP, 5300–4200 cal BP, 4300–3400 cal BP, 2850–1730 cal BP, and 1300– 750 cal BP (Jalut et al. 2000). Although these aridification phases

fall roughly between the lake-level highstands identified at Lake Accessa (see above), as might be expected, the overall drying trend indicated by pollen ratios at the millennial-scale is the opposite of the trend toward generally wetter climate indicated by lake-levels at Lake Accessa. This discrepancy between the results of Mediterranean-wide palynological studies and climate studies based on other forms of proxy data may suggest a complex relationship between climate and environment in the Mediterranean; however, it may also suggest that the relationship of some forms of proxy data, such as sedimentation rates, to climatic factors is still inadequately understood.

The increasing mediterraneanization of the Holocene environment has been found to be most strongly expressed in the south Mediterranean and along coastlines; interior and northern sites were found to have much weaker signals, to the extent that deciduous oak pollens in these areas were often as frequent at 3000 BP as they were at 9000 BP (Sadori, Jahns, and Peyron 2011:126). These findings suggest that, as with climate change, a north-south divide in environmental change may have obtained in the Mediterranean Holocene, with little permanent mediterraneanization taking place until the end of the period that is the focus of this study. Locating Sardinia within this north-south pattern of environmental change is essential for evaluating human interaction with the environment.

Two pollen studies are available from Sardinian latitudes. Although there is no reason to assume that local environments on Sardinia and local environments of other regions at Sardinian latitudes would have responded similarly to climatic events, the fact that these areas were likely to have experienced similar climatic events makes them a useful contextualization for the Sardinian data, especially given its paucity.

Pollen cores taken from Lago Grande di Monticchio, southern Italy (40°55'52.56"N, 15°36'22.40"E)(Watts et al. 1996), show the cold steppe flora of the Lateglacial disappearing around 10,000 BP to be replaced by mesic forests dominated by oak (*Quercus*) but with lower densities of other deciduous trees, including linden (*Tilia*), beech (*Fagus*), elm (*Ulmus*), hazel (*Corylus*), and species of the family Oleaceae. The mesic forest continued until about 4500 BP, with the addition of eastern hornbeam (*Carpinus orientalis/Ostrya*).

However, around 4500 BP, the flora around Lago grande di Monticchio changed

substantially with the expansion of firs (*Abies*), yews (*Taxus*), and common hornbeam (*Carpinus betulus*). This change in flora may suggest greater available moisture and a more favorable environment for drought-intolerant trees (Watts et al. 1996:124). A final change took place between 2500-2200 BP, when the percentages of firs and yews declined to local extinction, beech increases, and evergreen shrubs such as *Pistacia* and *Olea* appear. Although a slight increase in summer dryness might have slowed the growth of firs and yews, the authors consider forest clearance by humans to be the most likely explanation of the environmental change (Watts et al. 1996:124–125).

KET 8003, a marine core taken in the Tyrrhenian Sea at a latitude just a few minutes south of Sardinia's southernmost tip (38°49'12.00"N, 14°29'30.00"E), may also indicate human clearance of the landscape during the Holocene. The pollens in this marine core come from nearby Sicily and southern Italy, and trilete spores mostly of bracken ferns (*Pteridium sp.*) become very abundant after the Younger Dryas, which could indicate the opening up of the landscape, possibly caused by humans (Rossignol-Strick and Planchais 1989:414).

Environmental change on Sardinia

The environmental history of Sardinia is likely to be quite different from the mainland Mediterranean. As an island that lies quite distant from mainlands, Sardinia is subject to biogeographic pressures that would not have affected the mainland. These biogeographic pressures, including the presence of the large herbivore *Megaloceros* throughout the Late Pleistocene, may have created an initial Holocene environment completely unlike that of the mainland. The extinction of *Megaloceros* at the beginning of the Holocene (ca. 10,000 BCE) removed the only major herbivore then living on the island, allowing what may have been - by then - a badly denuded landscape to redevelop a forest cover (Schüle 1993:405). This process of redeveloping forest cover may have occurred slowly, again given Sardinia's distance from mainlands that would have provided sources of colonizing tree species. Evaluating the possibility of a pasture-dominated Sardinian environment at the beginning of the Holocene, and its potentially slow reforesting, can only be investigated through environmental studies of Sardinia itself, of which there are currently few.

Some support for the deforested Sardinian landscape of the early Holocene may come from a palynological study done on lagoonal organic shales from the Gulf of Cagliari, on Sardinia's southern coast (Porcu et al. 2007). This study suggests that the response to the Holocene climate optimum on Sardinia was the establishment of *Ericaceae* maquis, only subsequently followed by the establishment of the *Quercus* forest. This appears to have been followed by a drier phase indicated by *Chenopodiaceae* and more open landscapes ca. 7388±160 years BP, and then a return to oak forest between 7200 and 4800 years BP. A return to *Chenopodiaceae* is indicated for the period 4000-3000 yr BP, followed by a subsequent return to oak forest even in the coastal plains.

Excavated pollen data from an Early Neolithic site on Sardinia's west coast dating to the last three centuries of the 6th millennium BCE indicates an open landscape mainly covered by wild grasses and hydrophilous monocots with a low abundance of trees and very little *Pinus* pollen (Pittau et al. 2012). Given the propensity of *Pinus* pollen to travel long distances, the low amounts of *Pinus* pollen found in the excavated soils indicate that the open, grassy environment covered a large radius around the site itself. This is an interesting contrast with the findings from the Gulf of Cagliari, which indicate the predominance of oak forest at this time. The contrast suggests that the Sardinian environment was not uniform, and that local factors strongly affected environmental development.

Only one other pollen study for Sardinia could be located, a study of soils excavated at Nuraghe Arrubiu and the surrounding sites of the Muru Plateau: central, interior sites dating to the Late through Final Bronze Age, ca. 1365-1020 BCE (López, López Sáez, and Macías 2005). This study indicates a local environment that was heavily forested at the beginning of the Late Bronze Age, indicated by 80% arboreal pollen. By the end of the Late Bronze Age, the arboreal pollen had decreased to 20% and substantial cereal pollen was present. A continuation of low arboreal pollen and high cereal pollen was indicated for the Final Bronze Age, accompanied by severe depletion of soils. The site was abandoned at the end of the Final Bronze Age.

The indications of heavy forestation in the center of Sardinia in the Late Bronze Age contrast with the evidence from the Gulf of Cagliari for the same period, which indicates a grassland environment. This difference may be explained by differences in

elevation, however; the central part of Sardinia is more mountainous than the southern plains and receives more annual precipitation, which could have continued to support forests even as the lowlands transitioned to grasslands. The pollen record from the Muru Plateau is also the only palaeoenvironmental record from Sardinia to show the effects of human interaction with the environment, though this is not surprising given that there are only three studies and one of them is an extensive rather than localized study.

Nothing can be generalized from the three available palaeoenvironmental records for Sardinia. The only tentative conclusions that can be drawn are that Sardinia's environmental history is likely to differ from that of Mediterranean and European mainlands, and that local factors may have created striking differences in Sardinian landscapes at any given point during the Holocene.

CONCLUSIONS

Prehistoric Sardinians had a wide variety of resources and environments available to them. Good natural resources included building stone, very high quality flakeable stone, metal ores, and good agricultural soils. A diversity of landscapes provided marine and lagoon resources, fertile plains for planting, and hills and mountains with defensive capabilities. The island was not without its challenges, however. A severely underdeveloped hydrology may have constrained settlement locations and resulted in droughts on a fairly frequent basis. Additionally, the lack of large mammals of any kind on the island at the beginning of the Holocene, particularly the lack of large herbivores, may have made the procurement of high quality protein a greater concern for prehistoric Sardinians than locating sufficient botanical resources, and may have encouraged the introduction of wild mainland European fauna as well as the usual Neolithic domesticates.

It is difficult to say with certainty what climatic conditions prehistoric Sardinians faced. The complexity of reconstructing Mediterranean climate changes and the possibility of a marked north-south divide centered on 40°N latitude combined with the lack of proxy data obtained from Sardinia itself require that any conclusions be considered tentative. However, both scholars who identify a north-south divide and

scholars who challenge it agree that the period ca. 4300-2000 BCE was one of centennial-scale volatility for the Mediterranean in general, a scale of climate change that has been suggested to create adaptational difficulties for human populations. This period of volatility is also found in climate proxy data from sources at Sardinian latitudes, suggesting that 4300-2000 BCE should be considered a period of climatic stress and unpredictability on Sardinia, with possible effects on human behavior.

There is currently little evidence for environment on prehistoric Sardinia; however, what evidence there is suggests regional and local differences probably related to elevation and weather patterns. A patchy landscape could have offered numerous opportunities for local adaptation and specialization, and we may expect to observe regional differences in settlement and subsistence strategies during Sardinian prehistory. These regional differences were probably compounded by the differential distribution of raw materials throughout the island, and compounded again by the changing importance of these raw materials, particularly obsidian and metal ores.

Chapter 6: The Culture History of Pre-Nuragic and Nuragic Sardinia

INTRODUCTION

After reconstructing the general resource distributions and climatic and environmental factors that may have affected human behavior on prehistoric Sardinia, the next step in understanding the development of social complexity on Sardinia requires understanding the demographic, economic, and cultural factors that preceded the Nuragic Period, beginning with the Neolithic settlement of the island. This chapter aims to provide an overview of the culture history of Sardinia leading up to the Nuragic Period, as well as an overview of the Nuragic Period itself.

The island of Sardinia has some of the earliest records of human occupation of any island in the Mediterranean. Human presence on Sardinia has been suggested for the Lower Palaeolithic on the basis of possible Clactonion tools, dated by analyzing the formation processes of their associated palaeosols, but the genuineness of these finds has been hotly debated (Balmuth 1992:670; Martini 2009:23; Rowland 2001:10), with some authors accepting the pedological dates for the Clactonian tools (Martini 2009; Rowland 2001:10) and others remaining skeptical (Cherry 1992). Worked stone and bone, hunted fauna, and human osteological remains from the Upper Palaeolithic levels of Corbeddu Cave (Oliena-NU) on the east coast of the island give secure evidence of human presence at least as early as 20,000 uncal BP (Martini 2009:21–22).

Only four mesolithic sites are known on Sardinia. There are Mesolithic layers at Corbeddu Cave, and three other sites are located in the northwest of the island near the coast. Seven Mesolithic sites are known on Corsica, and the evidence from the two islands together has been taken to indicate their seasonal use as sources of coastal resources (Lugliè 2009a), though other scholars have interpreted the evidence as indicating continuous occupation of Sardinia from the Lower Palaeolithic onward (Lilliu

2002:221–222; Martini 2009).

Despite the early evidence for humans on Sardinia and the debate over continuous occupation, scholars agree that Sardinia was more densely settled only with the introduction of the Neolithic village economy. Agriculture and animal husbandry allowed for population expansion, and storage offered a degree of stability in Sardinia's unpredictable environment. Neolithic sites in Sardinia occasionally occur over Mesolithic sites, and it is possible that our knowledge of additional Mesolithic sites may be hindered by the effects of rising sea levels in the Holocene (Rowland 2001:11), but there are also Mesolithic sites without later Neolithic occupation, and the pronounced differences between the Mesolithic and Neolithic assemblages indicate that there was a marked discontinuity between the two cultures (Lugliè 2009b:38). The same conclusion has also been reached for the Mesolithic/Neolithic transition on mainland Italy (Biagi 2003; Skeates 2003).

NEOLITHIC SETTLEMENT AND SUBSEQUENT CULTURAL DEVELOPMENT

The Neolithic economy appeared on Sardinia in the first half of the 6th millennium BCE (Skeates 2003:172). The earliest dates come from the more northern provinces of Sassari and Nuoro, suggesting that Neolithic technology may have spread to Sardinia by way of Corsica, though more dates from the southern provinces of Oristano and Cagliari are needed. The Neolithic settlers on Sardinia encountered a landscape rich with a variety of natural and mineral resources (see Chapter 5). Monte Arci provided high quality obsidian, and in some areas, flints and jaspers were also available to be made into tools. In various regions, sandstone, limestone, tufa, granite, and basalt provided options for building structures, and chambers could be excavated into the softer stones to provide space for burials.

The Early Neolithic: The Cardial and Filiestru Cultures

The earliest Neolithic sites on Sardinia are characterized by cardial impressed

pottery that was probably brought to Sardinia by Neolithic settlers from the mainland. It is possible that the Neolithic village economy spread to Sardinia by way of cultural interaction and diffusion rather than direct settlement, but the currently inconclusive evidence for much mesolithic settlement on Sardinia suggests that settlement by mainland European groups is the more likely process of neolithization. The cardial impressed wares of the Sardinian Early Neolithic are similar to those found in southern France, Corsica, and northern Italy (Rowland 2001:11; Webster 1996:14), which may support the hypothesis that the Neolithic settlers of Sardinia came from southern France and northern Italy through Corsica. Some of the elements of the Neolithic economy that are present in Sardinia are absent in Corsica, a fact which has puzzled scholars in their attempts to reconstruct the Neolithic settlement of Sardinia; however, the pottery connections with northern Italy and France, as well as other trade connections that will be discussed below, indicate that it makes more sense to consider why Corsica might be unusual rather than discover a new route by which Neolithic Sardinia could have been settled.

Cardial impressed wares have been found at numerous caves, rock shelters, and open-air villages throughout the island. The early Neolithic settlement pattern is mainly coastal, though some sites occur 20-40 km inland (Rowland 2001:12). The importance of coastal resources in the early Neolithic diet is shown by the presence of large numbers of marine mollusk shells even at inland sites, and in general, hunting and foraging still made up a large part of the early Neolithic economy (Rowland 2001:14).

The extra-insular Cardial culture developed into an indigenous Sardinian Neolithic culture: the Filiestru culture, named after the Grotta Filiestru (Mara-SS) where it was first identified (Trump 1984). Filiestru pottery is basically an epicardial type; the forms of cardial impressed ware continue, but the impressed decoration is absent. The Filiestru economy seems to differ little from the cardial economy (Rowland 2001:14), and little is known about burial practices for either the Cardial or Filiestru cultures.

Transport and trade within Sardinia were somewhat limited in the Early Neolithic (6th millennium BCE). The presence of marine mollusks at inland sites shows regular movements of up to 40 km, and obsidian from Monte Arci did travel throughout the island. However, the density of obsidian at Early Neolithic sites varies with distance from

Monte Arci and with the availability of flints or jaspers as alternative raw materials (Phillips 1986:204). Apparently, the superior qualities of obsidian as a flaking stone were not sufficient to inspire regular, longer procurement trips, and intra-island networks were not sufficiently developed to solve the procurement problem. The lack of intra-island networks is fairly unsurprising given the mostly coastal focus of early Neolithic settlement on Sardinia.

Extra-insular transport and trade clearly occurred in the Early Neolithic, but were not intense. Sardinian obsidian was exported to Corsica, southern France, and northern Italy, but obsidian from Lipari was more common in these areas during the Early Neolithic (Phillips 1986:203–204). Sardinian obsidian became more frequent in mainland contexts in the second half of the 6th millennium and Sardinian pottery shows considerable mainland European influence (Rowland 2001:14); however, much stronger connections developed later.

The Middle Neolithic: The Bonu Ighinu and San Ciriaco Cultures

At the end of the 6th millennium and the beginning of the 5th millennium BCE, the Filiestru culture developed into the Middle Neolithic Bonu Ighinu culture. Named after the valley in northwestern Sardinia where the pottery was first identified, the Bonu Ighinu culture has both important continuities and important differences from the preceding Early Neolithic cultures. At some sites, such as at Grotta Filiestru, the Bonu Ighinu culture is preceded by the Filiestru culture. At other sites, such as Su Carroppu (Sirri-CI) and Capo S. Elia (Cagliari-CA) in the southwest and south-central parts of the island, Bonu Ighinu pottery shows similarities to cardial impressed wares (Rowland 2001:11), suggesting that there were regional differences in how the culture developed.

The Bonu Ighinu culture is more widespread than the Early Neolithic cultures; the sites are more numerous and are found deeper into the interior of the island (Rowland 2001:15). Bonu Ighinu sites are predominantly cave sites, though there are several open-air villages made up of wood or reed huts, including two very large villages near the lagoon of Mar 'e Pontis in Cabras. Bonu Ighinu sites were situated to take advantage of fish-filled lagoons and fertile river valleys and did not take advantage of hills and ridges

to control views, suggesting that defense was not yet a concern.

The economy of the Bonu Ighinu culture continued the traditions of the Cardial and Filiestru cultures, with perhaps more emphasis on agriculture. Shellfish continued to be an important resource, and animal husbandry made important contributions to the economy, though there is no general pattern of which animals were more important (Rowland 2001:15). Hunting continued to supplement the diet.

Distinct and recognizable burial practices began to be observed during the Bonu Ighinu culture. At the village of Cuccuru S'Arriu (Cabras-OR), cavities carved in rock outcroppings resemble prototype rock-cut tombs, and foreshadow later developments in funerary architecture. Grave goods included pottery, lithics, bone, and obese or rotund female statuettes. Intra-island trade and transport continued to be somewhat limited, but extra-insular trade became more intense in the Bonu Ighinu period. Pottery shows contacts with mainland Italy and Sicily (Rowland 2001:15).

The later San Ciriaco culture has only recently been recognized as separate from the Bonu Ighinu culture, and research on the San Ciriaco culture is still in a preliminary state. The San Ciriaco culture post-dates the Bonu Ighinu culture, and may represent the transition from the Middle Neolithic into the Late Neolithic. Two lines of evidence in particular support this interpretation. First, although there is some settlement continuity between San Ciricao and Bonu Ighinu settlements, San Ciriaco settlements are located less in caves and rock shelters and instead are predominantly open-air villages, as became common in the Late Neolithic. San Ciricao female figurines also suggest Late Neolithic styles. They are slenderer and more schematic than the obese, incised figurines of the Bonu Ighinu culture, pointing toward the geometric style that later became popular (Usai 2009:49, 54–58).

The Late Neolithic: The Ozieri Culture

By the beginning of the Late Neolithic (ca. 4000-3200 BCE), the first island-wide material culture had developed (Balmuth 1992:672; Rowland 2001:17). This culture is referred to as the Ozieri culture, or less frequently as the San Michele culture, after its type site at the cave of San Michele (Ozieri-SS). The Ozieri culture shows important

continuities with the preceding Bonu Ighinu and San Ciriaco cultures, but also significant developments.

There is some settlement continuity between the Bonu Ighinu culture and the Ozieri culture. Eight Ozieri sites had Bonu Ighinu antecedents (Rowland 2001:17), and several open-air Bonu Ighinu sites became very large villages in the Ozieri period, including Cuccuru S'Arriu (Rowland 2001:15–17). However, at least 127 known Ozieri sites did not have Bonu Ighinu antecedents, and seem to have been the result of settlement expansion and population growth (Rowland 2001:17). The shift in settlement type from caves and rock shelters (Usai 2009:49) to primarily open-air, unwalled villages (Rowland 2001:17) that may have begun during the San Ciriaco period was completed in the Ozieri period. The population increase and the shift to more open-air villages may be related to a greater reliance on and development of agriculture with respect to the preceding Early and Middle Neolithic cultures; there seems to be a correlation between areas of low agricultural productivity and small Ozieri burial chambers (Rowland 2001:19–20).

Ozieri burials built on the traditions of the simple Bonu Ighinu rock-cut tombs, such as the *tombe a forno* found at the cemetery of Cuccuru S'Arriu. However, the Ozieri rock-cut tomb, the characteristic *domus de janas*, was often much more elaborate. There are around 2500 *domus de janas* on Sardinia, ranging from monocellular chambers to elaborate, multi-cellular complexes and cemeteries (Rowland 2001:19). The more labor-intensive d*omus de janas* were carved in the shape of Ozieri huts, with numerous burial chambers and antechambers decorated with false architectural features such as roof beams, columns, and hearths. *Domus de janas* in the north and central parts of the island were sometimes decorated with bull's head and geometric, mostly spiral, motifs in red or polychrome paint or carved in relief (Rowland 2001:21).

Some Ozieri burial customs also developed from previous Bonu Ighinu customs. In particular, the practice of placing a female figurine with the deceased continued, but with a very different type of female figurine. While the figurines of the Bonu Ighinu period were obese with carved faces, headdresses, arms, and legs, the majority of the Ozieri figurines were severely geometric and lacked carved features with the exceptions of noses and breasts. Again, the transition from the Bonu Ighinu to the Ozieri type may

have occurred during the recently identified San Ciriaco culture (Usai 2009:57), and may be related to a trend toward creating female figurines that more closely resembled the very geometric female forms that were incised on both Bonu Ighinu and Ozieri fine pottery (Rowland 2001:24).

There is strong evidence for food offerings and ritual meals taking place in the antechambers of *domus de janas*. Some *domus de janas* had channels, pits, cavities, and containers that may have been for food offerings. Tomb I of Molia (Illorai-SS) had several cavities in the antechamber that contained carbonized grain and animal bones, presumably from birds (Rowland 2001:21; Sadori, Tanda, and Follieri 1989). The small, undisturbed *domus de janas* at San Benedetto (Iglesias-CI) had ashes, carbonized botanical material, and burnt animal bones just inside the entryway. Undisturbed *domus de janas* at Anghelu Ruju (Alghero-SS) preserved evidence of funerary offerings or meals consisting mostly of lamb and shellfish, and more varied funerary offerings were found at Su Crucifissu Mannu (Porto Torres-SS). Hearths and tripod vessels found in some *domus de janas* suggest ritual meals (Rowland 2001:20–21).

An interesting development of the Ozieri period is the establishment of cult spaces that appear unconnected to funerary ritual. This is an innovation of the Late Neolithic, though settlement continuity indicates development out of Middle Neolithic Bonu Ighinu antecedents. There are only two known sites of this type dating to the Ozieri period, the most impressive of which is Monte D'Accoddi (Porto Torres-SS). Monte D'Accoddi is a monumental, stepped platform constructed of earth and stones topped with an altar reached by a sloped causeway. It was originally built in the Late Neolithic at the site of a previous Middle Neolithic village, where both Bonu Ighinu and San Ciriaco artifacts have been identified. Village occupation continued around Monte D'Accoddi after the foundation of the monumental platform, and the cult site remained in use throughout the Late Neolithic and into the Eneolithic. The meaning of the development of a new kind of ritual seemingly unconnected to death is debated; however, it is generally agreed that the space was intended for large public gatherings. The rarity of these open-air cult spaces may suggest that whatever cultural development they indicate, it was not universally shared in the Neolithic. Alternatively, a site like Monte D'Accoddi may have been meant to attract visitors from great distances, indicating cultural unity over a wide

region.

The pottery production of the Ozieri culture continued the forms of the Middle Neolithic, but also innovated a wide variety of new forms, including tripod vessels for cooking directly over hot coals and squat, box-like vessels known as pyxides (sg. pyxis) (Tanda 2009:63). The proliferation of new forms suggests that the profound cultural changes that occurred during the Late Neolithic also affected foodways, perhaps changing methods of food preparation or indicating differences in the foods prepared. At the least, it is possible to say that cultural change during the Late Neolithic was pervasive.

Perhaps one of the most important developments in material culture during the Ozieri period was the first use of metal. Silver and copper both began to appear in small amounts in Ozieri villages, burials, and cult sites, and occurred with more or less equal frequency in these three types of sites (Melis 2009:85). These metal artifacts are mainly fragments of copper blades and pins and copper and silver jewelry. The finds are not frequent enough to indicate serious metal working activity, but interest in metals may have increased by the end of the period: metal working equipment such as crucibles and tuyeres occur in Late Ozieri and early Eneolithic contexts (Lo Schiavo 1986:232; Tylecote, Miriam S. Balmuth, and Raniero Massoli-Novelli 1984:125).

ENEOLITHIC CHANGES

The Eneolithic (ca. 2700-2000 BCE) on Sardinia was another period of important change. Settlement patterns shifted, metallurgy increased in importance, subsistence practices changed, iconography and symbolism changed dramatically, and the unified material culture of the Ozieri period fragmented into numerous regional styles. After the progressive development of the Neolithic cultures toward greater island-wide unity culminating in the florescence of the Ozieri culture, the fragmentation of the Eneolithic and its dramatic departures from Ozieri precedents indicates a key moment in Sardinian prehistory.

Attempts to reconstruct the chronology of the Sardinian Eneolithic have interpreted the many recognizably distinct material cultures both as linear, progressive

developments and as contemporaneous regional variations (Rowland 2001:25). The chronological debate is an involved one, and will not be discussed here. In general, the Filigosa and the Abealzu cultures, primarily identified in the north of the island, appear to be somewhat older than the Monte Claro culture, which is more associated with the center and south of the island. However, Monte Claro and Abealzu-Filigosa do appear to be contemporaneous for much of the Eneolithic, and there does appear to be a regional variation of Monte Claro pottery that occurred later in the north, discovered at Nuraghe Noeddos (Mara-SS) where it was named Noeddos ware (Rowland 2001:28). Although the pottery styles of the Eneolithic cultures differ, many of the other important changes of the Eneolithic occurred in all areas of the island more or less simultaneously. The Eneolithic will therefore be discussed here simply as the Eneolithic, without trying to place the regional cultures in precise chronological order.

During the Eneolithic, settlement patterns shifted away from coastal and lowland sites more toward upland sites (Lewthwaite 1986). There was some settlement continuity between Ozieri villages and Eneolithic villages (Rowland 2001:28), but not enough to argue against the reality of the settlement shift. This change in settlement location has been associated variously with an increased interest in metal ores (Melis 2009:93), which occur in the mountainous regions of the island, and with an increased interest in defense (Lilliu 2002:230; Rowland 2001:28). The conclusion that defense became more important in the Enolithic is strengthened by the occurrence of fortified villages associated with both Abealzu-Filigosa and Monte Claro pottery (Moravetti 2009:99–100; Rowland 2001:29).

The importance of defense in the Eneolithic has been used to argue that the population growth seen in the Neolithic continued during the Eneolithic, eventually to the point of causing tensions (Rowland 2001:26). The greater number and larger size of Monte Claro villages compared with Ozieri villages in the south (Rowland 2001:29) seems to support this conclusion. However, other scholars have claimed a general decrease in the number of sites in the Eneolithic (Melis 2009:93), which may not in itself disprove the population expansion hypothesis if greater population nucleation was occurring.

The Eneolithic use of metal increased substantially from the earlier experiments

of the Ozieri. Both Abealzu-Filigosa and Monte Claro sites show substantially more metal objects (Melis 2009:85–87; Rowland 2001:29), and the use of lead to repair broken pottery was introduced. However, the use of metal artifacts remained far from ubiquitous. Of 300 known Monte Claro sites, just over ten have metal artifacts (Moravetti 2009:102). Daggers were the most common metal artifact in Monte Claro contexts (Moravetti 2009:102), and daggers became increasingly common in Abealzu-Filigosa contexts, particularly in burials (Melis 2009:87).

Symbolism changed dramatically in the Eneolithic, and the change is particularly evident in a new form of ritual practice: the creation and placing of menhirs and statue menhirs. Throughout the Neolithic, images of human figures predominantly represented females. This changed in the Eneolithic. Although many of the menhirs of the Eneolithic were aniconic or decorated solely with geometric patterns, many were also figural. These figural menhirs overwhelmingly represented males; a study of statue-menhirs found 150 that represented males and only eight that represented females (Lilliu 2002:232). Additionally, daggers were often represented on the statue-menhirs, offering further indications of the increasing role of violence in Eneolithic culture. While it is certainly over-interpreting to suggest, as Lilliu has, that this change in iconography indicates a shift from a peaceful, female-dominated Neolithic to a violent, male-dominated Eneolithic (Lilliu 2002:230), it is equally certain that the change in iconography did accompany and reflect profound cultural changes (Rowland 2001:26), and that the incorporation of violence into daily life was probably one of them.

Subsistence also seems to have changed in the Eneolithic. Although the evidence available is currently not extensive, stable isotope analysis of human remains from the Eneolithic indicates less meat in the diet than was consumed during the Ozieri period, probably resulting from the increased consumption of agricultural products. It has been suggested that this increased reliance on agriculture was caused by an increased focus on craft production, particularly metalworking, which the storable surpluses agriculture could produce made possible (Melis 2009:93).

Cult practice shows both continuity and change in the Eneolithic. The important cult center at Monte D'Accoddi was destroyed by fire toward the end of the Late Neolithic, but it was then rebuilt and elaborated during the Eneolithic to be larger and

more impressive than its Ozieri predecessor. There is at least one statue-menhir at the site of Monte D'Accoddi, and the sides of the new platform were painted red (Tanda 2009:69), which may have been an extension of the polychrome painting common in *domus de janas* to a new ritual context. However, new stands of statue-menhirs were also established during the Eneolithic in places where there were no pre-existing Late Neolithic monuments.

One of the only aspects of Eneolithic culture that does not seem to have changed from the Late Neolithic is burial types. The earlier Neolithic forms, particularly the *domus de janas*, were continued without substantial alteration or development. This is particularly interesting given how pervasive change was in other parts of Eneolithic culture. It is possible that whatever social organization the Neolithic tombs reflected and whatever social meaning they had remained current and applicable in the Eneolithic despite the other cultural changes. It is also possible, however, that changes that have not yet been recognized archaeologically did occur, such as a shift in which members of society were honored by placement in these tombs.

THE NURAGIC PERIOD

Many of the changes that began to occur in the Eneolithic, including the use of metals and settlement pattern shifts toward the interior of the island, continued and intensified during the Bronze Age. The Bronze Age also saw the rise of Sardinia's characteristic Nuragic culture, the first development of social complexity on the island. The Nuragic culture is generally defined by its building of large stone towers called nuraghi (sg. nuraghe). These towers evolved architecturally during the Nuragic Period, but in their "classic" form, they were shaped like truncated cones and contained two or three chambers stacked vertically, reachable by an intra-mural staircase (Image 10). In addition to the shared architectural form of the nuraghe, similarities in funerary and cult architecture, pottery styles, tools, and household objects indicate a high degree of interaction among Nuragic societies. However, some regional differences in funerary architecture and pottery styles did occur.

Image 10: A "classic" single-tower tholos nuraghe at the site of Santa Cristina in Paulilatino (OR).

Whether the Nuragic culture began in the Early Bronze Age or whether it began only in the Middle Bronze Age is a debate that partially depends on the dating of early Nuragic architecture and partially depends on how one chooses to define the beginning of the Nuragic culture. Early Bronze Age developments clearly provided the foundations for the social organization that produced the Nuragic towers, and there may have been "lag time" between the first development of hierarchical social organization and the creation of the highly archaeologically visible corridor nuraghi. However, I prefer to restrict the definition of the Nuragic culture to include only the period in which forms of nuraghi were built and inhabited, recognizing that the actual hierarchical organization of Nuragic societies may have developed slightly before this.

In the past two decades, a developing rift can be observed between continental European scholarship on the Nuragic Period, primarily conducted by Sardinian scholars,

though continental Italian, Spanish, and French scholars have also played an important role, and some of the more visible scholarship on the Nuragic Period published in English. Some of the anglophone studies have relied heavily on the traditional interpretations of Nuragic chronology and development first posed by Lilliu based on his excavations at Nuraghe Su Nuraxi in Barumini (Dyson and Rowland 2007; Webster 1996). However, these chronological divisions and their meaning for Nuragic society and culture have been much debated in the past two decades in light of the discoveries of subsequent excavations and the accumulation of more radiocarbon dates. While some English treatments of the Nuragic Period have discussed chronology in greater detail (Van Dommelen 1998; Rowland 2001), the traditional Nuragic chronology is generally the chronology that is repeated and used as the basis for further research (Blake 1999; Webster 1990; Webster 1991).

Several of the traditional interpretations of Nuragic culture that are familiar to scholars whose primary work is in English will be challenged here, in particular, the interpretations that the Nuragic culture, defined by the construction of corridor nuraghi, began in the Early Bronze Age, that Nuragic architectural development shows a clear progression, and that Nuragic culture can be considered to persist past the first fifty years of the Early Iron Age. My challenges of the traditional interpretation are not based on my own new excavation data, though these data will later be shown to be in alignment with my interpretation of Nuragic chronology. In challenging the familiar interpretations, I am taking sides in a debate that has been occurring in continental European scholarship for some time, but which has not yet been very visibly acknowledged in anglophone scholarship.

The Early Bronze Age

The Early Bronze Age (c. 2000-1700 BCE) is frequently cited as the period when the Nuragic culture first emerged (Webster 1996). The identification of the Early Bronze Age as the beginning of the Nuragic Period is based on the assertion that corridor nuraghi, the first type of nuragic structures, were first built in the Early Bronze Age. Corridor nuraghi are monumental dry masonry platforms, each with one or more narrow

corridors running through them (see Image 11). They often have small, roughly circular or elliptical rooms branching off the corridors (Lilliu 1982:13–29). Housing structures, probably made of wood or other perishable materials, were built on top of these platforms, and food or livestock were probably kept in the corridors and small rooms below. Corridor nuraghi are considered to be the predecessors of the later single-tower nuraghi, also called "classic" or "simple" nuraghi, and their appearance is agreed by most to signal the beginning of the Nuragic culture.

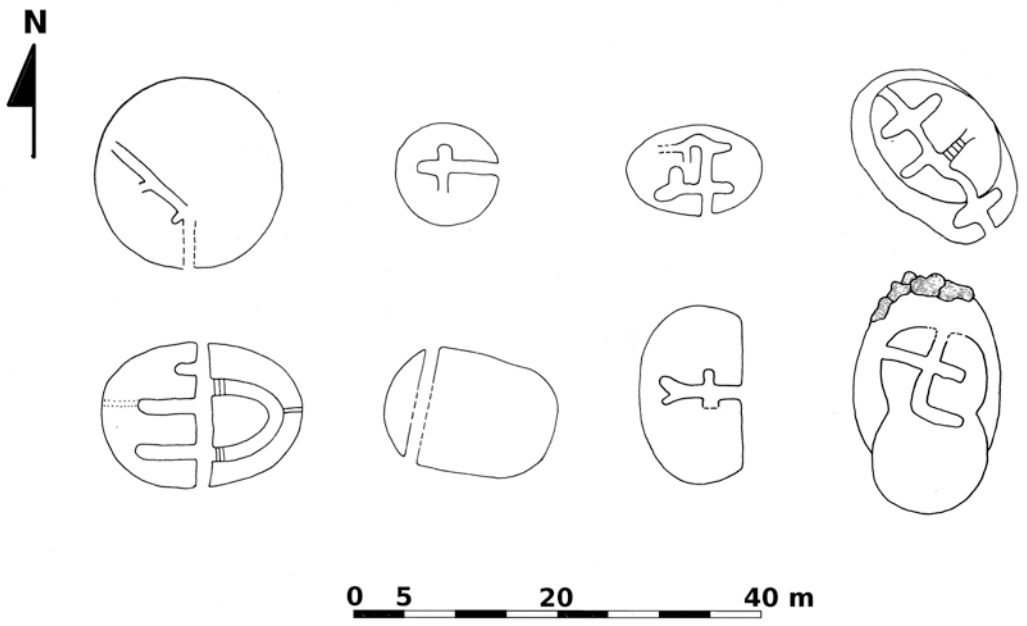


Image 11: Plans of corridor nuraghi. Top row, left to right: Nuraghe Sant'Alvera, Ozieri (SS); Nuraghe Cunculu, Scan Montiferro (OR); Nuraghe Siligogu, Silanus (NU); Nuraghe Tusari, Bortigali (NU). Bottom row, left to right:NUraghe Seneghe, Suni (OR); Nuraghe Gianna Uda, Bonarcado (OR); Nuraghe Lighedu, Suni (OR); Nuraghe Aidu Arbu, Bortigali (NU). After Lilliu 1982:16-17.

Corridor nuraghi have been dated to the Early Bronze Age based on a few broad radiocarbon dates (Lilliu 2002:236), comparison with radiocarbon-dates from the architecturally-similar *torri* (towers) in Corsia (Lilliu 2002:236), and by the presence of a supposedly Early Bronze Age pottery type, Sa Turricula pottery, in corridor nuraghi

(Santoni 2009). Corridor nuraghi have often been placed in a strict architectural typology along with the single-tower nuraghi and multi-tower or "complex" nuraghi, meaning two or more attached towers which frequently included an attached, walled courtyard. Corridor nuraghi are assumed to belong only to the Early Bronze Age, single-tower nuraghi to the Middle Bronze Age, and multi-tower nuraghi to the Late Bronze Age (Manca Demurtas and Demurtas 1992; Webster 1991; Webster 1996).

In recent years, this typology has been abandoned by many scholars and the identification of corridor nuraghi as Early Bronze Age monuments has been questioned. The radiocarbon dates which place corridor nuraghi in the Early Bronze Age have broad error ranges that include dates in the Middle Bronze Age. Additionally, no pottery that can be identified as belonging to the widely-recognized Early Bronze Age culture, the Bonnanaro culture, has been identified in occupation layers of corridor nuraghi. Although Sa Turricula-type pottery has been found in corridor nuraghi, the identification of Sa Turricula as an Early Bronze Age pottery style has been questioned (Depalmas 2009a). No pottery securely associated with relative dating earlier than the Middle Bronze Age has been found in corridor nuraghi. It seems safer, then, to assign the corridor nuraghi to the beginning of the Middle Bronze Age and consider the culture of the Early Bronze Age to be a pre-Nuragic culture, although the early social and economic changes that created the Nuragic culture must have begun during this period.

If we exclude the corridor nuraghi from consideration, the settlement history of the Sardinian Early Bronze Age becomes quite sparsely represented. Early Bronze Age pottery, known as Bonnanaro ware after the type site at Corona Moltana (Bonnanaro-SS), is found primarily in funerary contexts. The people of the Bonnanaro societies frequently continued long funerary traditions, reusing *domus de janas*, caverns, cists, and gallery graves (Rowland 2001:33). Undisturbed *domus de janas* at Anghelu Ruju, Santu Pedru (Alghero-SS), and Su Crucifissu Mannu show unbroken use from the Late Neolithic Ozieri culture through Early Bronze Age Bonnanaro (Rowland 2001:20).

Bonnanaro groups also made their own burial sites *ex novo*, as at Corona Moltana. This site has been identified as an undisturbed *domus de janas* containing only Bonnanaro pottery. The style of the tomb continued Ozieri funerary traditions, but the outside of the tomb had a facade carved with a door motif, an innovation in symbolism

that points toward new developments in funerary architecture and possibly in burial practices.

The Beginning of the Middle Bronze Age: Continuity and Change

Secure radiocarbon and relative dating indicates that the first corridor nuraghi were built at the beginning of the Middle Bronze Age (Depalmas 2009a), meaning that the Middle Bronze Age (ca. 1700-1365 BCE) can be taken to be the start of the Nuragic Period as defined by the appearance of Nuragic architecture. Major changes in settlement organization and craft production accompanied the new developments in architecture, demonstrating a pervasive social change.

However, before discussing the innovations of the Middle Bronze Age, it is important to point out that while much changed, one important continuity with the past was maintained. The characteristic funerary architecture of the Nuragic Period, the so-called giants' tombs, were directly related to the earlier tomb types of the Eneolithic and Early Bronze Age. In plan, the Nuragic giants' tombs are simply Eneolithic passage graves with a curved forecourt added (see Image 12). These forecourts were constructed of stelae and the central stele was often carved with a door motif, symbolism that had already begun to develop in the Early Bronze Age as seen on the entrance to the Bonnanaro *domus de janas* at Corona Moltana. In several instances, earlier passage graves were elaborated into giants' tombs, including the sites of Su Cuaddu de Nixìas (Lunamatrona-VS), Li Lolghi (Arzachena-SS), and Coddu Vecchiu or Capichera (Arzachena-SS). Examples of cist graves and dolmens that were transformed into giants' tombs are rarer, but also exist. The construction and decoration techniques of the giants' tombs combined the architecture of the passage graves and dolmens with the carving techniques of the statue-menhirs. Giants' tombs often incorporated reused menhirs, and many giants' tombs are built near pre-existing menhirs, suggesting intentional ritual continuity.

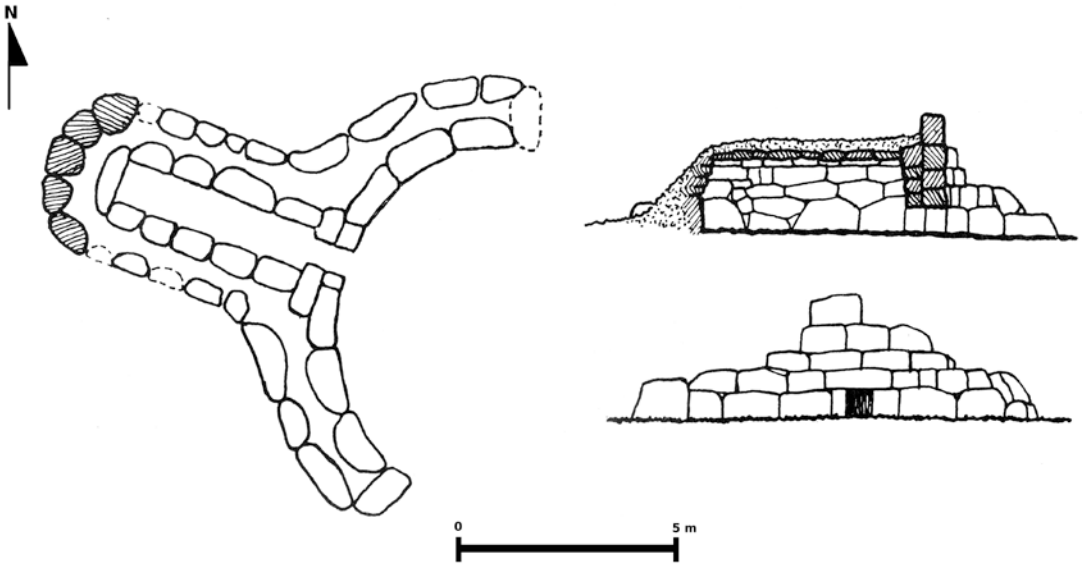


Image 12: Plan (left), section (top right), and front view (bottom right) of a typical giants' tomb, Muraguada (Bauladu-OR). After Lilliu 1982:47.

Other architectural developments tend to suggest change rather than continuity, however. The most visible innovation of the Middle Bronze Age was the construction of the corridor nuraghi, also called protonuraghi or pseudo-nuraghi, though these terms have been criticized as being teleological and the term corridor nuraghi will be preferred here. As discussed above, corridor nuraghi are monumental dry masonry platforms, usually with one or more narrow corridors running through them and habitations in perishable materials constructed on top of them. About 280 corridor nuraghi have been identified. They occur most densely in the provinces of Oristano and Nuoro followed by Sassari and then Cagliari (Manca Demurtas and Demurtas 1992:176). Corridor nuraghi tend to be located on hills and plateaus about 300-400 m above sea level, near sources of good building stone and streams or springs (Manca Demurtas and Demurtas 1992:178).

Corridor nuraghi are variously interpreted as falling everywhere in the scale of social organization, from being the farmsteads of egalitarian family groups (Webster 1991; 1996) to being nodes along semi-organized communication lines (Manca Demurtas and Demurtas 1992) to being evidence of chiefdom-level social hierarchy (Lilliu 2002). The identification of corridor nuraghi as single-family egalitarian farmsteads is drawn implicitly from a sense of social evolution based on Lilliu's original Nuragic chronology

and supported implicitly by the assumption that the lack of known MBA villages in many areas where corridor nuraghi occur indicates that the only occupation of these areas occurred in corridor nuraghi (Webster 1991). However, it should be kept in mind that very few villages are known from the preceding Bonnanaro period as well. The fact that the village architecture of the Early Bronze Age was highly perishable and that Early Bronze Age village occupation is not very visible archaeologically, even as pottery scatters, suggests that the same may be true of Middle Bronze Age village architecture. It is important to keep in mind that even the habitation structures built on top of corridor nuraghi were perishable, and have left only traces of their existence. It is therefore a mistake to assume that the occupation of the corridor nuraghi represents the total population of Sardinia during the Middle Bronze Age. Indeed, a catastrophic decrease in population size from the Neolithic/Eneolithic to the Middle Bronze Age would be required for the entire population of Sardinia to fit into approximately 280 single-family dwellings. Finally, although they are few and far between, some villages are known from the Middle Bronze Age (Depalmas 2009a:129). We should therefore assume that the construction of the corridor nuraghi represents some type of socio-cultural difference between the inhabitants of corridor nuraghi and the inhabitants of villages.

Although the corridor nuraghi should not be taken to be the single family dwellings of an egalitarian society, their identification as evidence of chiefdom-level organization also seems hard to defend. While corridor nuraghi do indicate some of the classic archaeological markers of social hierarchy, such as residential segregation (Peebles and Kus 1977), and the associated giants' tombs may or may not represent burial segregation, there is still little evidence for the elevated levels of production associated with the political economies of highly stratified societies. Corridor nuraghi and giants' tombs would have required group effort to construct unless they were constructed over very long periods of time (Webster 1991), but they do not require the high levels of group output associated with chiefdoms. Also, with the exception of new pottery styles (discussed below), there are no major changes in material culture that accompany the building of the corridor nuraghi. Giant's tombs did not receive appreciably more grave goods than Eneolithic and Early Bronze Age burials, and there is no observable florescence of prestige goods, though high levels of production of perishable goods

cannot entirely be ruled out.

A pronounced change in pottery styles did occur between the Early Bronze Age and MBA, possibly connected to the same social changes indicated by the development of the corridor nuraghi. The footed-vessel pottery styles that were common in the Eneolithic and Early Bronze Age disappeared in the Middle Bronze Age, to be replaced by new types of cooking wares. These included low-walled pans and large, round-bottomed, upside-down cooking jars that were used as portable ovens: food was placed under them and hot coals piled on top. Also, vessels known as "milk boilers" that have an internal rim for holding a perforated strainer appeared in this period, perhaps connected to cheese production. Together, these changes indicate food preparation techniques that moved away from stews and porridges toward bread, baked foods, and possibly cheese.

Given the evidence for some kinds of cultural continuity as well as important changes, it makes the most sense to think of the Middle Bronze Age as a period when the prehistoric Sardinians were experimenting with new social structures and identities (Blake 1999). The new identities do seem to have had elite connotations, using the corridor nuraghe to establish residential segregation and a new type of monumental display associated with living individuals rather than dead ancestors. Incipient elite identities may also have been expressed by new types of food preparation emphasizing tastier baked and roasted foods over boiled foods. These efforts to establish elite identity, and the evidence provided by the corridor nuraghi that individuals were able to motivate group labor for personal ends, indicate that the Middle Bronze Age was the period in the Nuragic culture when some level of social complexity first developed.

Further Developments During the Middle Bronze Age

The social and cultural changes that started at the beginning of the Middle Bronze Age continued and gained momentum during the following three centuries. The simple techniques used to construct the corridor nuraghi at the beginning of the Middle Bronze Age were followed less than two centuries later by the discovery of how to build false-tholos and true tholos chambers: false domes created by stacking courses of stones in rings of decreasing diameter (Lilliu 1982:30–61, see Image 13). This innovation allowed

the creation of larger rooms with higher ceilings. Many corridor nuraghi were elaborated and expanded into more complex structures with the addition of false-tholos and tholos chambers: this continuity of occupation can be seen at numerous sites in Sardinia such as Sa Fogaia (Siddi-VS), Su Mulinu (Villanovafranca-VS), and Santa Vittoria (Serri-NU).

Agglomerative building, the elaboration of existing structures over time through the addition of new walls and towers, is a practice generally associated in the scholarly literature with the Late and Final Bronze Age, again based on Lilliu's classic Barumini chronology (Blake 2001; Lilliu 1982; Webster 1996). However, it is important to recognize that the practice of agglomerative building and the creation of complex nuraghi is part of the nuragic culture from very early on. "Complex" nuraghi are not limited to the well-known multi-tower tholos nuraghi of the later Nuragic culture. Although the Late and Final Bronze Age multi-tower tholos nuraghi are substantially larger, more impressive, and more recognizable even after they have partially collapsed (corridor nuraghi often look simply like piles of stone), the practice of building complex structures and elaborating earlier structures is not an invention of the later Nuragic culture. It is simply more visible in the later structures.

Thousands of new nuragic sites were constructed beginning in the mid-Middle Bronze Age, around the 16th century BCE. Many of these sites were single-tower nuraghi, though some were multi-tower nuraghi. The construction of giants' tombs also changed during the course of the Middle Bronze Age, drawing on the improved architectural techniques of the tholos nuraghi. The orthostatic stelae construction that had been carried over from earlier Eneolithic tombs was replaced by courses of stones inclining toward an arched ceiling, and the central stele with door motif was replaced by a simple opening with a stone architrave between the two wings of the forecourt (Blake 2001; Castaldi 1968; Castaldi 1969). The new, nuragic-type giants' tombs were generally built closer to nuraghi than the previous orthostatic type, and were often intervisible with the nuraghi (Blake 1999:47). This change in the structuring of nuragic landscapes has been interpreted as an intentional move by the inhabitants of the nuraghi to more closely co-opt and control the power and identity associated with giant's tombs (Blake 1999), suggesting that the processes of power consolidation continued successfully after their first appearance in the early corridor nuraghi.

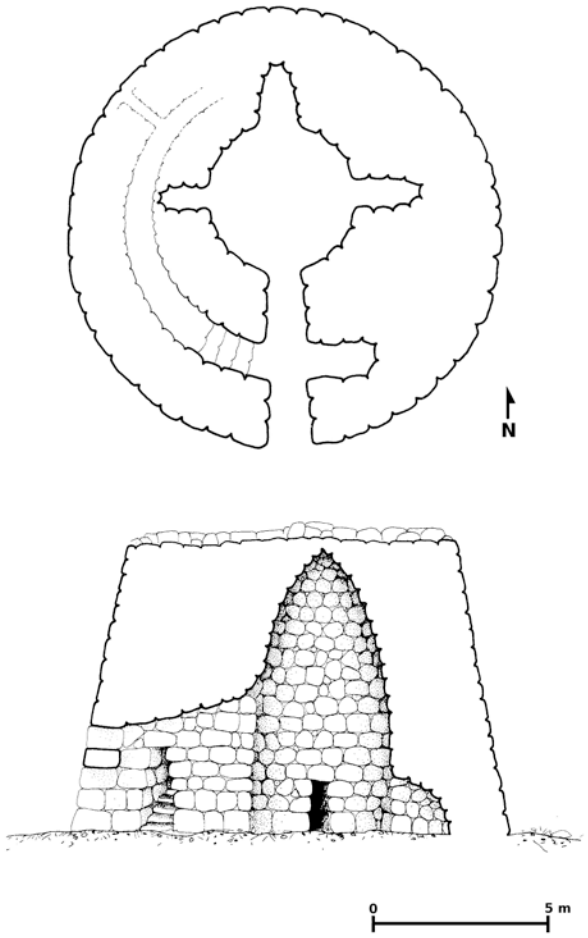


Image 13: Plan and section of a typical single-tower nuraghe built in the true tholos style. In a true tholos nuraghe, the stones near the top of the corbel are small than those at the base. In a false-tholos nuraghe, the opposite is true. After Lilliu 1982:53.

Finally, new pottery types and styles of decoration developed in the Middle Bronze Age. The metopale jar, a large, closed form decorated with rectangular or triangular zones filled with impressed designs, appears around the middle of the Middle Bronze Age. By the end of the Middle Bronze Age, spatial patterning and regional styles in pottery decoration began to appear. An early form of comb-impressed or "*a pettine*" ware characterized the end of the Middle Bronze Age in the north of Sardinia, but was absent from the south.

The Late Bronze Age: Consolidated Power

The MBA/LBA transition saw the establishment of many of the imposing Nuragic complexes (see Image 15) that served as regional centers during the Late (ca. 1365-1175 BCE) and Final Bronze Age (c. 1175-1020 BCE). The central towers of the Nuragic complexes of Santu Antine (Torralba-SS), Losa (Abbasanta-OR), and Arrubiu (Orroli-NU) were founded in the mid 14th century BCE, while their subsidiary towers and earliest occupation layers date to the LBA (see Image 14). The architecture of these three

Image 14: Nuraghe Santu Antine (Torralba-SS) has a particularly integrated architectural design showing careful planning and constructionover a long period.

complexes shows that they were constructed according to unified plans created at the Middle Bronze Age/Late Bronze Age transition and carried out in the following century (Depalmas 2009b:138). The ability of the elites controlling these sites to create and follow complex architectural plans over the course of a century suggests that some Nuragic elites were very solidly established by the Middle Bronze Age/Late Bronze Age transition.

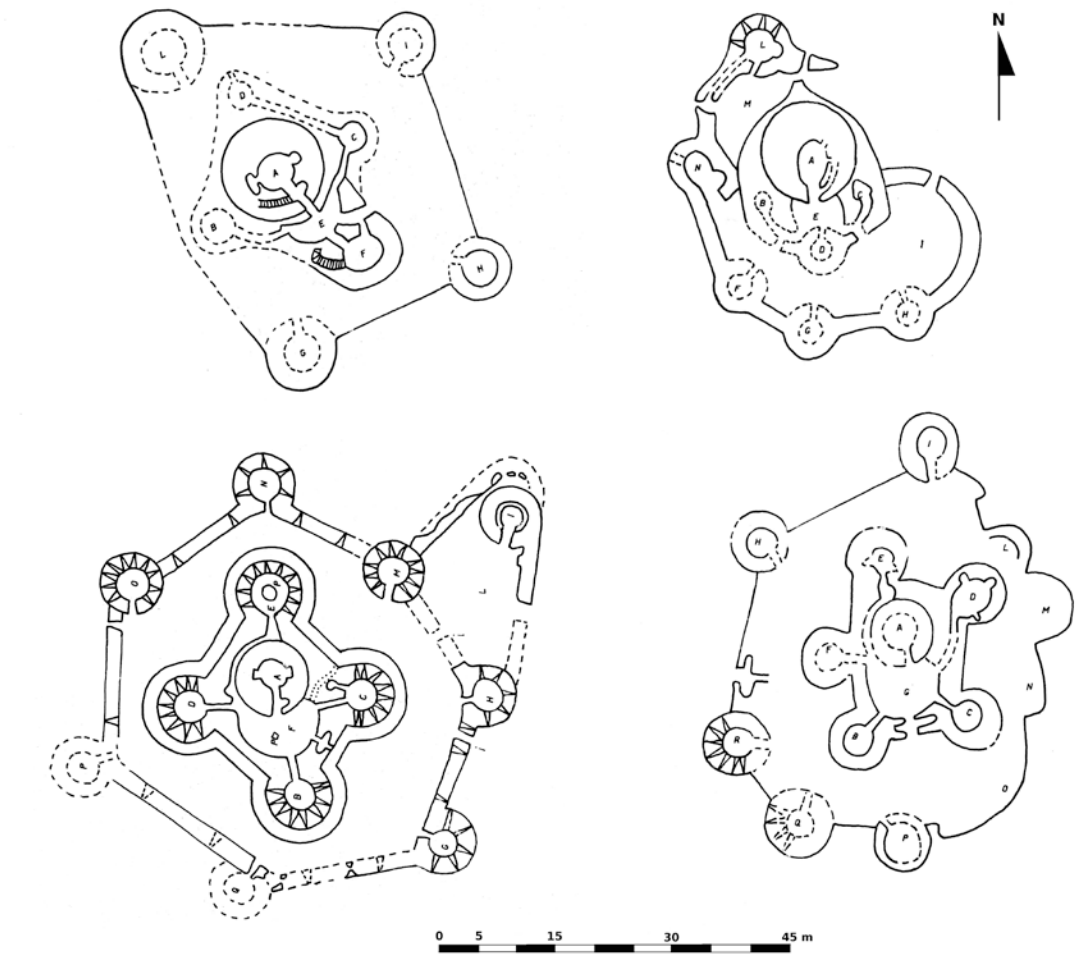


Image 15: Plans of four nuragic complexes: Lugherras (Paulitatino-OR, top left), S'Orku (Domusnovas-CA, top right), Su Nuraxi (Barumini-CA, bottom left), and Arrubiu (Orroli-CA, bottom right). After Lilliu 1982:76.

However, elites in other areas may have experienced more contested paths to dominance during the Late Bronze Age. The central tower of the Nuragic complex of Su Nuraxi (Barumini-CA) was founded at the end of the Middle Bronze Age as a single-tower structure. During the Late Bronze Age, this single-tower nuraghe was elaborated with the addition of four subsidiary towers positioned around the central tower. Three towers enclosed a courtyard with a well, and a fourth tower with a deep storage pit could be reached from the courtyard by a narrow passage wrapping around the wall of the central tower. The entrance to the new, multi-tower nuraghe was at ground level through

a doorway in the courtyard. Later in the Late Bronze Age, a refacing wall was added to the structure. The refacing wall sealed off the ground-level entrance and created a new entrance 14 m off the ground that could have been reached only by climbing some kind of ladder. Once inside the entrance, the passage through the wall itself was steep and narrow, and the stairs of the passage stop several meters above the floor of the courtyard. Again, some kind of ladder would have been necessary to reach the courtyard floor.

Like the Late Bronze Age refacing wall that made access to Su Nuraxi substantially more difficult, further additions to Su Nuraxi also emphasize defense. During the Late Bronze Age, a small village of circular huts grew up around the multi-tower nuraghe (see Image 16); this village was then surrounded by a circuit wall. Circuit walls are a common feature of nuragic complexes and are found at many multi-tower nuraghi, including Santu Antine, Losa, and Arrubiu. However, at many nuragic complexes the defensive nature of the circuit wall is not so clearly corroborated by the architecture of the nuraghe itself; indeed, the ground-level entrance and extremely open floor plan of Nuraghe Santu Antine would have made it difficult to defend if enemies made it inside the circuit wall.

In light of the varying levels of care to guard against attackers shown by the construction of different nuraghi, it seems the Nuragic elites of the Late Bronze Age experienced different levels of resistance to the consolidation of their power. Whether this resistance came from unhappy subjects or rival elites is uncertain, because it is not currently known whether the LBA villages surrounding nuraghi represent habitation by subjects or habitation by minor lineages and/or specialists associated with the elites. Also, the full extent of many of these villages has never been determined, making it difficult to judge whether these villages could have accommodated the full population required to build the large nuragic complexes. The fact that villages without associated nuraghi persisted in the LBA (Depalmas 2009b) indicates the presence of settlement hierarchies in which not all subjects had equal access to Nuragic elites, or of unaffiliated producers who may have wanted to resist incorporation by elites, or both. Wherever the perceived threat to elite power came from, it is clear that, for some elites, the process of power consolidation continued into the LBA.

Image 16: The village surrounding Nuraghe Su Nuraxi (Barumini-VS), seen from the top of the central structure. Photo E. Holt.

New developments in the construction of giants' tombs also point toward greater power consolidation by the elites. Some giants' tombs built during the LBA lacked the curved forecourt, which has been interpreted as a weakening of the communal ritual that had been associated with giants' tombs in the past. More prestige items, such as glass and amber beads and metal objects, were also found inside the tombs without forecourts (Depalmas 2009b:139).

New forms of cult architecture began to develop in the LBA. Most noticeable was the sacred well or *pozzo sacro* (Depalmas 2009b:139), which utilized the tholos-construction technique of the nuraghi to create underground, vaulted chambers over naturally occurring springs (see Image 17). The elaboration of natural springs with architectural elements began as early as the Nuragic culture itself. Some basic sacred wells occurred in the MBA, but their typical architectural construction was established

only in the LBA with the development of true tholos architecture (Lilliu 2002:246). The typical sacred well consists of an underground chamber created by building a tholos-structure over a spring and a monumental stairway leading down to the water. A hole at the top of the tholos chamber lets in light and a reflection of the sky. Sacred wells often include a sacred area delimited by a stone wall, sometimes with a bench, presumably to seat observers of the water ritual. Sacred wells dating to the LBA include the sacred wells at Cuccuru S'Arriu and Cuccuru Nuraxi (Settimo San Pietro-CA) (Depalmas 2009b:139).

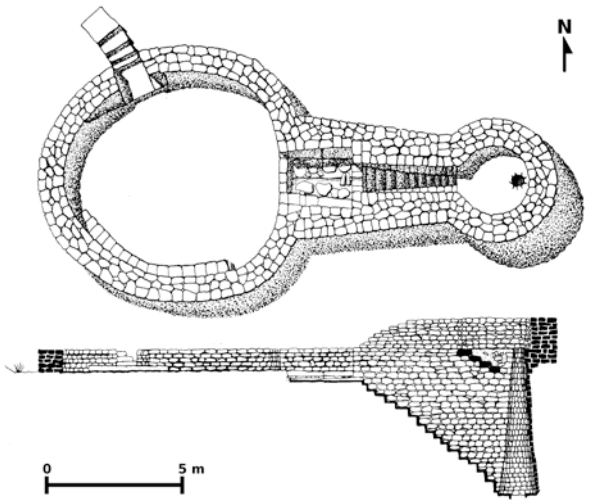


Image 17: Top view and section of a typical well temple, Sa Testa (Olbia-OT). After Lilliu 1982:63.

Water had always been important to the Nuragic culture. Middle Bronze Age corridor nuraghi were always built near water sources and later LBA nuraghi and nuragic complexes almost always incorporated wells, either within the circuit wall of the nuragic complex as at Nuraghe Palmavera (Alghero-SS) or within the courtyard of the nuraghe itself as at Nuraghe Su Nuraxi (Barumini-CA). Nuraghe Is Paras (Isili-CA) even has a well within the central tower itself. Nuraghe Santu Antinue has two wells, one in the courtyard and one in a subsidiary tower. This tower can be entered from the nuraghe but also directly from the outside, suggesting that the well served not only the Nuragic elite, but also the community, and may have incorporated a ceremonial function similar to that of the developing sacred wells.

The increasing importance of water ritual in the LBA may suggest further consolidation of elite power through the absorption and elaboration of ceremonial functions, as well as through the perceived or real control of an essential resource. It may also suggest that water was becoming scarcer or less reliable during the later Nuragic period. While the nature of climate change in Sardinia is difficult to reconstruct without further research (see discussion in Chapter 5), climate regimes both north and south of the 40°N dividing line indicate centennial-scale changes beginning around 1450 BCE: a decrease in precipitation after a short lake level highstand in the north and large fluctuations with an overall drying trend in the south. Either of these climatic regimes could have created a sense of precariousness surrounding the availability of water, making water and wells a particularly charged symbol for the elite to control.

Two other forms of cult architecture that may also have begun in the Late Bronze Age were meeting huts or *cappane della riunione*, large circular huts with a low bench running around the inside wall, and the so-called megaron temples, named after their architectural resemblance to the megaron houses of the East Mediterranean. The dating of meeting huts and megaron temples to the LBA rests on only a few sherds of pottery from a few sites, however, so it is probably best to attribute the full development of these cult places to the FBA. Meeting huts and megaron temples have very different spatial distributions. Meeting huts are found near nuraghi in nuragic complexes and near large cult sites such as sacred wells, which suggests that they were linked to elite-led ritual. In contrast, megaron temples are generally found in upland areas away from large sites. They are small, utilizing only basic construction techniques. The differences in form, geographical distribution, and architectural association between meeting huts and megaron temples may suggest the development of two different traditions of cult practice, one elite-led and the other representing autonomous practice by producers who were either outside of elite purview or resisting it.

Material culture also saw important changes in the Late Bronze Age. The use of large storage jars or *dolia* increased substantially, suggesting increases in production as well as greater elite control of subsistence products. The differences in ceramic production between the north and south of the island that were beginning by the end of the Middle Bronze Age were thoroughly established in the Late Bronze Age. A fully

developed form of *a pettine* ware characterized the north, while undecorated "Nuragic gray ware" or *ceramica grigio-ardesia* characterized the south. These two wares were spatially mutually exclusive, and the southern preference for Nuragic gray ware may be due to external influence and the greater contact the south of the island had with the Mycenaeans (Depalmas 2009b:134).

Pottery production was not the only craft that began to look eastward for inspiration and influence. Metallurgy and metal production also shifted their focus from western and central Europe to the eastern Mediterranean, especially Cyrpus (Lo Schiavo 1986). A general increase in the number of imported materials entering the island occurred at this time (Russell 2010); however, recent research has failed to find a correlation between foreign materials and large nuragic complexes (Russell 2010), finding instead a stronger correlation between large nuragic complexes and sources of copper ore (Russell 2010). This suggests that, while contact with the East Mediterranean was a source of stylistic influence and technical knowledge, control of East Mediterranean trade was not the source of power for Nuragic elites (Russell 2010).

The Final Bronze Age and Early Iron Age: A Shift in Power Symbolism and the End of the Nuragic Culture

The events of the Final Bronze Age (ca. 1175-1020) and Early Iron Age (ca. 1020-900) present some difficulties, because the pottery of the later Final Bronze Age cannot be distinguished from that of the Early Iron Age. This has led to a debate in the scholarly community about how to interpret the end of the Nuragic Period on Sardinia (Ugas 2009:164–165). This debate cannot currently be resolved because it rests on differing interpretations of excavated stratigraphy without sufficient radiocarbon dates. The interpretation presented here follows scholars such as Lilliu, Contu, Ugas, and Bernardini in assigning certain events and types of material culture to the Early Iron Age rather than the Final Bronze Age (*contra* Lo Schiavo, Santoni, and Manunza). However, some of the interpretations of events presented by these scholars, particularly Lo Schiavo, are found to be consistent with the chronological understanding followed here.

The Final Bronze Age witnessed the most important florescence of the Nuragic

culture. New nuraghi were no longer constructed though the existing nuraghi remained in use, and instead monumental building focused on the elaboration of cult architecture. During the Final Bronze Age, the new forms of cult architecture that first appeared in the Late Bronze Age, particularly the sacred wells, reached their most developed forms. The precisely cut and elegantly fitted blocks of the larger sacred wells, such as the sacred well at Santa Cristina (Paulilatino-OR), show the highest level of skill in stone masonry demonstrated by the Nuragic culture (see Image 18). The isodomic giants' tombs, with their similarly well-cut stones in carefully laid courses, serve as an additional demonstration of the specialization achieved by Nuragic stonemasons. The isodomic giants' tombs are in even closer proximity to nuraghi than the preceding nuragic-style tombs, suggesting an ever-stronger link between elites and the symbolism of giants' tombs (Blake 1999:48–49).

Image 18: The entryway (left) and monumental staircase (right) of the sacred well of Santa Cristina. Photos E. Holt.

Giants' tombs are not the only burials known from the Final Bronze Age. Burials in caves have also been discovered, and osteological analysis of the remains in cave burials and giants' tombs show important differences in nutrition and disease, with the healthier individuals being found in the giants' tombs (Depalmas 2009c:148–149). Although it is debated whether Middle Bronze Age and Late Bronze Age giants' tombs were true community burials or instead burials limited to an elite lineage (Bernardini 2010; Russell 2010:112; Webster 1996), it seems that at least by the Final Bronze Age

there was clear burial segregation between a privileged elite and the rest of the population.

The clear and dramatic changes that occurred during the Final Bronze Age have been interpreted as indicating different cultural processes. Some scholars have interpreted them as indicating the further consolidation of power by the existing elite, extending it to include the complete take-over of religious power and authority. Other scholars have seen them as indicating the loss of power by the secular elite, suggested by the cessation in nuraghi building, and the simultaneous rise of a religious or priestly elite who controlled community ritual. Given that there is no evidence for a group of religious specialists separate from the elite during the preceding Middle Bronze Age-Late Bronze Age, and indeed that spatial patterns indicate a growing connection between the elite and sites with ceremonial significance such as giants' tombs, the first explanation seems more plausible.

THE EARLY IRON AGE

At the Final Bronze Age-Early Iron Age transition, the Nuragic culture seems to have experienced a crisis. The existing nuraghi were allowed to collapse, and they were abandoned as dwellings. Many fell out of use completely, and those that remained in use were treated as ritual spaces, taking on a ceremonial function they had not previously had. New villages were sometimes built around nuraghi that had not previously had villages, often utilizing stones from the collapsed nuraghe itself, as at Nuraghe Su Nuraxi, or building huts on top of the collapsed circuit walls, as at Nuraghe Genna Maria (Villanovaforru-VS). Even the floor plans of the Early Iron Age houses were different from those of the Bronze Age. Bronze Age houses tended to be circular in plan, but the houses of the Early Iron Age were composed of many sub-circular and sub-rectangular rooms around an open courtyard. Evidence from the Early Iron Age village of Genna Maria indicates that these rooms had distinct functions, unlike the undifferentiated space in Bronze Age houses. The new Iron Age villages also differed from their Bronze Age predecessors by being open-air villages lacking fortifications and circumference walls.

No new monumental architecture was built after the Final Bronze Age until after the Phoenicians had begun to establish trading colonies on the island in the 8th century

BCE. New constructions, such as the huts of the Iron Age villages, lacked both the size and the sophisticated stone-cutting techniques seen in the well temples and giants' tombs of the preceding period. Funerary behavior also changed in the Iron Age. Communal burial in giants' tombs ceased and was replaced by individual burials, such as the famous burials at Monti Prama (Cabras-OR). The new individual burials, like the new villages, cannot be dated earlier than the 9th century BCE, and often seem more likely to date from the 8th-7th century BCE.

According to one side of the chronological debate, the Early Iron Age is the period when the characteristic bronze votives known as *bronzetti*, miniature models of nuraghi, and geometric pottery appear (Ugas 2009:165). Other scholars place these innovations in material culture in the FBA, but this interpretation of the stratigraphy seems less likely. The available radiocarbon dates place the courtyard house villages, where geometric pottery and miniature nuraghi are primarily found, in the 9th-7th centuries BCE, at least one century and as much as several centuries after the end of the FBA. This apparent break in settlement continuity is unsurprising, given that it would have been dangerous to build villages around nuraghi while they were still in the process of collapsing. Both the radiocarbon dates and the superposition of Iron Age villages on top of collapsed nuraghi argue for a hiatus of at least a century between the end of the FBA and the beginning of the characteristic Iron Age material culture. However, we should expect there to be variation in when this transition occurred at different sites, with some sites remaining occupied by a Nuragic culture through the first century of the Early Iron Age.

Bronzetti are found primarily in cult contexts, such as well temples and reused nuraghi, but given the impressive and monumental nature of these structures, their continuity as foci of ritual activity cannot be taken simplistically to indicate continuity of the Nuragic society. The *bronzetti* also have far greater stylistic affinity with artistic developments of the later Iron Age, such as the monumental statues of Monte Prama dated to the 8th-7th century BCE (Tronchetti 1986), than with any iconography known from the Middle Bronze Age-Final Bronze Age.

An examination of the evidence suggests that much of what is currently attributed by some scholars to the Early Iron Age and considered a continuation of Nuragic culture

is actually likely to post-date a 100-200 year hiatus in occupation at Nuragic sites. The assumption that the Nuragic culture continued during the Iron Age (Dyson and Rowland 2007; Lilliu 1982; 2002; Webster 1996) is implicitly based on perceived settlement continuity, continuity of the deposition of votive offerings in sacred wells, and continuity in some styles of pottery. Additionally, it is assumed that some skills, such as the ability to work metal, could not have been maintained through a decrease in social organization. The case for Nuragic continuity is seldom argued outright since it is generally assumed rather than problematized. As I have argued above, however, none of the factors used as evidence can be considered proof of the continuity of the Nuragic society. The pervasive changes that occur during the Early Iron Age, including the cessation of monumental building indicating the loss of any centralized ability to motivate labor, the pronounced changes in household architecture suggesting changes in family organization, the change of function of the nuraghi, and the abandonment of burial in giants' tombs, all strongly indicate that the culture of the Iron Age had changed substantially from the Nuragic culture of the preceding Bronze Age. Only activity that is reliably datable to the first part of the Iron Age, ca. 1020-900 BCE, can potentially be considered a remnant of the Nuragic culture, reordering and redefining itself, sometimes with reference to its monumental past, in the wake of profound cultural change.

CONCLUSIONS

The culture history of Sardinia leading up to the Nuragic Period can be understood as leading to the profound changes of the Nuragic Period itself. From the first lasting, widespread settlement of the island in the Early Neolithic, population on Sardinia grew and settlements expanded, developing regional cultures and engaging in trade both within and outside the island that began as limited but grew increasingly in scope. By the Late Neolithic, strong communication lines crossed the island, evidenced by the widespread distribution of obsidian from Monte Arci throughout Sardinia and the development of the first uniform material culture: the Ozieri culture.

The Eneolithic witnessed important changes, probably influenced by continued population growth and perhaps by increasing interest in metal production. There is

evidence for both population expansion and greater nucleation, accompanied by a shift in settlement locations from river valleys and lowlands to defensible ridges and hilltops. The appearance of some fortified villages underscores the growing interest in defense. The use of metal increased slightly during the Eneolithic, imagery shifted from representing primarily females to representing primarily males, often shown armed, and the unified material culture of the Late Neolithic fragmented once more into primarily regional styles.

The Early Bronze Age saw the continuation of the trends begun in the Eneolithic, culminating in the beginning of the Nuragic culture during the Middle Bronze Age. The Nuragic culture is the first clearly stratified culture on Sardinia, with residential segregation on a monumental scale. The Middle, Late, and Final Bronze Ages appear to have been times of increasing power consolidation and a reorientation of extra-insular contacts away from western and central Europe toward the East Mediterranean. Metallurgy developed significantly, and cult practice changed and gained in political importance.

The Nuragic society began to collapse at the end of the Final Bronze Age. The social structures needed to motivate labor disintegrated: no new monumental building, whether nuraghi or sacred wells, was undertaken after the Final Bronze Age. Though activity continued at some Nuragic sites in the Early Iron Age, most of this activity has the character of a changed social organization redefining itself in terms of material culture that it can no longer produce, an active relationship with a defunct system rather than a true continuation of the system. Much of the Iron Age occupation that occurred around abandoned nuraghi and that has often been considered Nuragic postdates the Nuragic decline by at least two centuries and should more properly be considered evidence of a new culture.

Chapter 7: Complexity, Economy, and Environment during the Middle Bronze Age on the Siddi Plateau: Archaeological Background and New Research

INTRODUCTION

The abundance of basalt bedrock, excellent sight lines, difficult access, and nearness of key resources made the Siddi Plateau an attractive place for Nuragic leaders to establish their strongholds, whether these were powerful lineage heads or incipient elites. Fifteen corridor nuraghi were built around the circumference of the plateau, and a sixteenth nuraghe was begun but never finished. A giants' tomb was built in the interior of the north of the plateau. These archaeological sites have been known to scholars for many decades and were first formally described in the 1940s in a short article by Giovanni Lilliu (Lilliu 1941). Since then, however, only sporadic mentions have been made of the plateau and surprisingly little archaeological work has taken place there. This chapter will provide an introduction to the archaeological remains on the Siddi Plateau and the previous research that has taken place at these sites. It will then outline the research design and general results of the work I designed to apply the model presented in Section I to the Middle Bronze Age settlement system of the Siddi Plateau.

NURAGHI

Sixteen nuraghi are evenly spaced around the circumference of the Siddi Plateau (Image 19). This group of nuraghi includes single-tower, polylobate, and complex nuraghi (Table 3) constructed in the corridor architectural style associated with the beginning of the Nuragic culture; it also includes three nuraghi whose original form could not be determined accurately because they have been largely dismantled for building

stone. None of the nuraghi on the Siddi Plateau incorporate examples of true tholos construction, but at least two and possibly more incorporate false tholoi, an innovation in architecture that is thought to date to the latter part of the Middle Bronze Age and which points toward the true tholos building technique available by the Middle Bronze Age/Late Bronze Age transition (see discussion in Chapter 6). Based on the current understanding of Nuragic architecture, the establishment of the settlement system on top of the Siddi Plateau is likely to date to the early-mid Middle Bronze Age, but new construction seems to have ceased just before the Middle Bronze Age/Late Bronze Age transition, although occupation may have continued. Pottery from one of the two previous excavations on the plateau confirms the Middle Bronze Age date of Sa Fogaia, one of the nuraghi.

Table 3: Monuments of the Siddi Plateau

Monument Name	**Translation**	**Monument Type**
Su Gruxi	The Cross	Single-chambered corridor nuraghe
Su Pardu	The Pasture	Single-chambered corridor nuraghe
Sa Conca Sa Cresia	The Head of the Church	Multi-chambered corridor nuraghe with additional towers, refacing wall, external tower, and courtyard
Molas	Millstones	Single-chambered corridor nuraghe
Genna Maiu-A	Door of May-A	Single-chambered corridor nuraghe
Genna Maiu-B	Door of May-B	Single-chambered corridor nuraghe
Corruardu (a contraction of Corru 'e Pardu)	Horn of the Pasture	Single-chambered corridor nuraghe
Pranu Casti	Guardian of the Plateau	Single-chambered corridor nuraghe
Su Concali	The Head (i.e. of cattle)	Single-chambered corridor nuraghe
Corona Arrubia	Red Summit	Multi-chambered corridor nuraghe
Liccu	Manger (probably)	Single-chambered corridor nuraghe
Pranu Strintu	Narrow Plateau	NID
Sa Mammonaia	The Little Grandmother (probably, but this word is not in dialect of Sardo local to Siddi)	Uncertain - monument never finished
Sa Fogaia	The Kiln	Multi-chambered corridor nuraghe with additional tower and courtyard
Cuccuru (or Bruncu) Bingias	The Hill of the Vineyards	NID
Su Sensu	(a type of plant native to the plateau)	NID
Sa Domu 'e s'Orcu	The House of the Orc	Coursed-stone giants' tomb

The limited area of the Siddi Plateau and the roughly even spacing of the nuraghi around its circumference suggest that the nuraghi were sited in order to take advantage of the plateau's defensibility and maximize the inhabitants' visual and economic control of the lowlands. The lowlands surrounding the plateau are likely to have been the location of producer habitation as well as most agricultural activities due to the adverse agricultural conditions on top of the plateau. Both the lowlands and the plateau itself may have been locations for wood procurement, pastoralism, and the procurement of wild foods. It is likely that bronze production, if it did play a crucial role in the early Nuragic political economy, would have been located on the plateau near the homes of the segment heads. Evidence from other early nuraghi indicates that bronze smelting took place in or around them (Webster 1988; Webster and Webster 1998).

Image 19: Locations of the sixteen nuraghi (dots) and one giants' tomb (square) on the Siddi Plateau.

The architectural evidence of the sixteen nuraghi themselves suggests that the inhabitants of the nuraghi may have been competing with each other to attract and control followers. Some of the nuraghi never grew larger than a single corridor, while others have multiple corridors, false-tholos chambers, courtyards, and refacing walls; these differences in size and complexity indicate varying levels of success in capturing labor. Changes in construction techniques, most visibly the addition of false-tholos chambers at Sa Fogaia and Sa Conca Sa Cresia and the changing wall construction techniques at Sa Conca Sa Cresia, indicate that this process of capturing labor happened over time.

Additional evidence that labor capture was not always successful comes from Sa Mammonaia, a nuraghe which was begun but never finished. Its footprint is wide for a nuraghi, possibly too wide to have been roofed successfully with the technology of the time. There is also no evidence for collapse, as there is at all the other nuraghi on Siddi Plateau that have not been mostly destroyed to build more recent constructions. The collapsed nuraghi are surrounded by heaps of stones from the upper stories, but Sa Mammonaia has only two courses of stones with no evidence for collapsed upper stories. It is possible that the stones from the collapsed structure were carried off to be used in other building projects, whether during the Bronze Age or for the more recent construction of property demarcations, animal pens, and shepherds' huts. Other nuraghi on Siddi Plateau were cannibalized for use in constructing modern structures, however, and most continue to show evidence of collapse.

Only two archaeological projects had taken place on the plateau prior to my research. Unfortunately, these projects remain largely unpublished, though some information about the nature of the finds from both projects is available. One of the projects was an excavation at Sa Fogaia (Scientific Director, A. Atzeni; Field Director, M. Perra; Image 20), which produced pottery dating to the end of the Middle Bronze Age. Later Nuragic pottery was not found at Sa Fogaia; however, the structure was reoccupied in the Punic period and additional small square huts were built around it (M. Perra, pers. comm.). The lack of later Nuragic materials should not be taken simplistically to indicate no Late or Final Bronze Age occupation occurred at Sa Fogaia; post-Nuragic reoccupations may have destroyed the later Nuragic layers. However, the complete lack of Late and Final Bronze Age building techniques on the plateau, when considered with

the lack of later Nuragic pottery at Sa Fogaia, does seem to suggest that later Nuragic occupation was not intensive, if it did occur.

Image 20: The false-tholos tower of Sa Fogaia (left) and the courtyard (right). Photos E. Holt.

GIANTS' TOMB

A seventeenth ancient structure on the Siddi Plateau is a giants' tomb called Sa Domu 'e s'Orcu, located in the center of the north branch of the plateau (see Image 19 for location). Sa Domu 'e s'Orcu is constructed in the later, "nuragic" architectural style of giants' tombs, incorporating monumental shaped blocks laid in courses, rather than in the earlier style of carved stelae stood on end; it is often cited as a fine example of coursed-stone giants' tomb architecture (Image 21). Unfortunately, like most of the prominent giants' tombs in Sardinia, Sa Domu 'e s'Orcu has long since been looted, so no data about human remains or grave goods can be recovered. However, limited excavations carried out at Sa Domu 'e s'Orcu during a restoration project uncovered Middle Bronze Age pottery in the foundation layers, then Punic and Roman pottery indicating later reoccupation (Balmuth 1992:687). Again, the lack of Late and Final Bronze Age pottery does not conclusively demonstrate a lack of later Nuragic occupation, but considered in conjunction with the lack of Late and Final Bronze Age pottery at Sa Fogaia, excavations at Sa Domu 'e s'Orcu further suggest that the plateau was indeed abandoned or all but abandoned at the end of the Middle Bronz Age.

Image 21: Front and side views of Sa Domu 'e s'Orcu. Photos E. Holt.

A POSSIBLE EARLY SACRED WELL

A final constructed feature on the plateau that may date to the Middle Bronze Age is a spring or water collection pit with a constructed superstructure located near Sa Conca Sa Cresia in the north of the plateau (Image 22). Very little notice has been taken of this feature, and opinions are divided as to whether it is likely to date to the Middle Bronze Age. Lilliu mentions the structure briefly as being related to Sa Conca Sa Cresia and Sa Domu 'e s'Orcu and takes it as further evidence of Nuragic occupation on the plateau (Lilliu 1988:335). However, another Sardinian archaeologist who has worked extensively

Image 22: Water feature near Sa Conca Sa Cresia with closeup of roof structure with hole. Photos E. Holt.

in the area, Mauro Perra, is convinced that it is a later construction made by shepherds for watering sheep (M. Perra, pers. comm.).

I find the interpretation of this structure as a shepherd's watering hole unlikely due to its construction. The built structure actually limits access to the water rather than facilitating it, and the stones are not stacked high enough to provide shade for the sheep drinking there. In the three years that I excavated at this site, I never saw sheep drinking from this structure, though sheep were often present in the immediate area. Also, the style of the architecture points toward the form of the later, fully developed sacred wells, if only in a general way. The intent to create a doorway leading to water and a covering with a hole in it over the spring itself can clearly be seen in the structure near Sa Conca Sa Cresia. This is also the basic form of fully developed sacred wells, except that the invention of tholos construction techniques allowed the doorway to be placed underground and preceded by a monumental staircase (cf. Image 18).

THE SIDDI PLATEAU IN REGIONAL CONTEXT

Although the sixteen nuraghi, giants' tomb, and possible sacred well are the only known archaeological remains on the Siddi Plateau itself, the plateau is in an area that shows high levels of occupation both leading up to the Middle Bronze Age and following it (Image 23). Neolithic occupation has been shown by the chance find of late Neolithic hypogeum burials in the lowlands to the east of the Siddi Plateau (Lilliu 1988:63, 136, 589). This site, Scaba 'e Arriu, was discovered accidentally during the plowing of a field. The burials contained Abealzu and Monte Claro wares together in a single layer overlaying an earlier Ozieri layer. These burials indicate Neolithic occupation in the area, though the location of an associated Neolithic village is currently unknown. Eneolithic occupation is also clear for the area surrounding the plateau. An Eneolithic gallery grave, Su Cuaddu de Nixias (Lunamatrona-VS) is located a short distance south of the plateau (Image 24). This gallery grave was later transformed into an early, stele-style giants' tomb during the Early Bronze Age. Both the Eneolithic and Early Bronze Age dates have been confirmed by pottery finds during excavation.

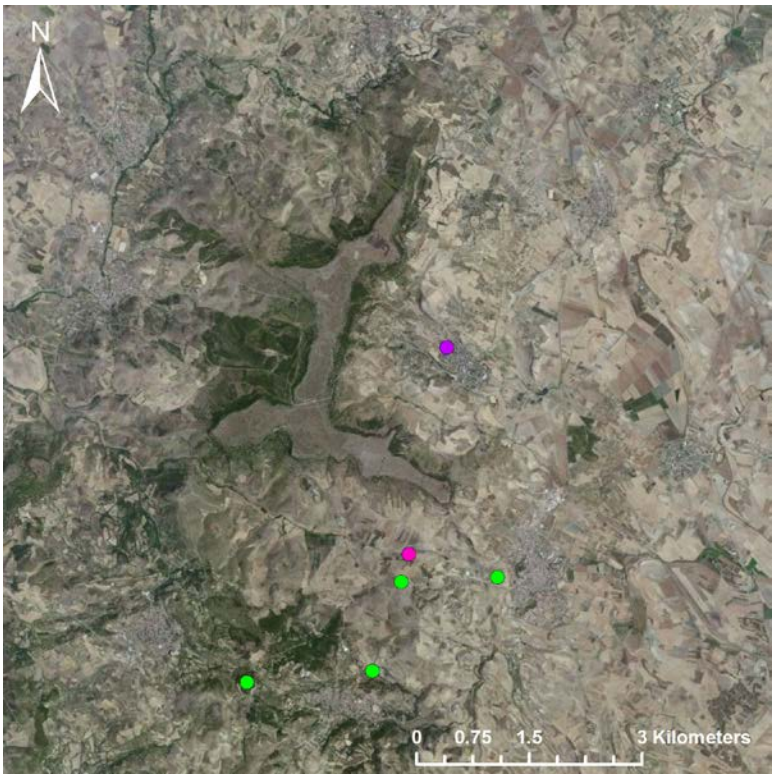


Image 23: Other sites in the Siddi Plateau area. Purple dot: Neolithc hypogeum burials. Pink dot: Eneolithic/Early Bronze Age gallery grave/early giants' tomb. Green dots: Late Bronze Age tholos nuraghi.

Image 24: Su Cuaddu de Nixias: the carved stele and the remains of the forecourt (left) and the burial chamber (right). The stone outline of the smaller Eneolithic passage grave can be seen in the right image, nearest to the viewer. Photos E. Holt.

Although there does not appear to be any Late or Final Bronze Age occupation on the Siddi Plateau, there is clear later Nuragic occupation in the lowlands to the south. A small Late Bronze Age tholos nuraghe with an attached well is located near Su Cuaddu de Nixias, and a slightly larger tholos nuraghe is located on a hill about 1.2 km to the east. Another small tholos nuraghe, Pinna Maiolu, is located about 1.6 km farther south from Su Cuaddu de Nixias near the modern town of Villanovaforru. Finally, an extensively excavated nuragic complex with a polylobate nuraghe and a circuit wall, Nuraghe Genna Maria, is also located near Villanovaforru, about 2.7 km southwest of Su Cuaddu de Nixias. Together, these monuments suggest that the area south of the Siddi Plateau developed as a small Late Bronze Age settlement system, possibly with Nuraghe Genna Maria as the center of regional power.

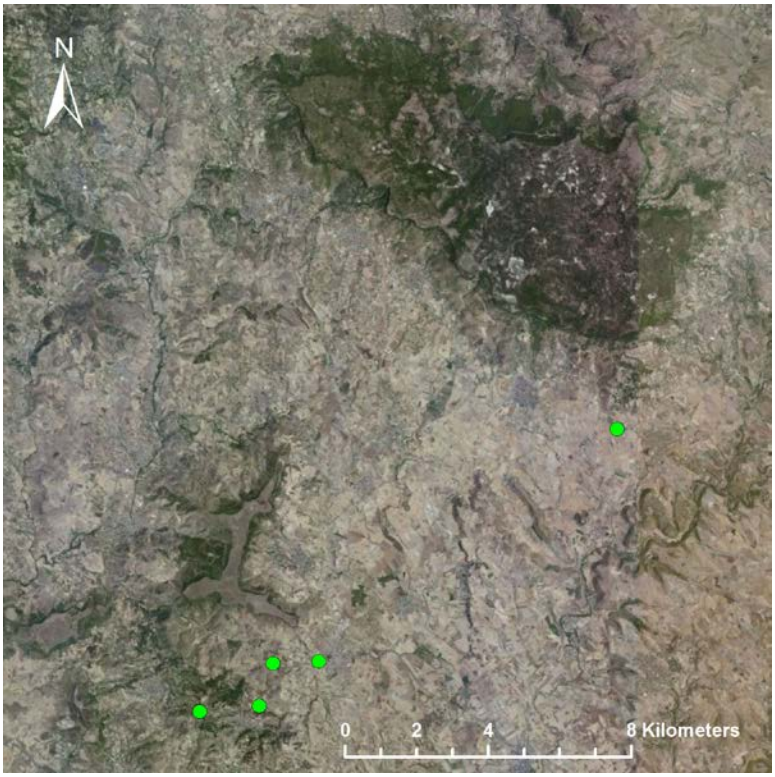


Image 25: The Late Bronze Age sites near the Siddi Plateau and the Late Bronze Age site of Su Nuraxi to the northeast. Su Nuraxi is the probable center of a large settlement system on and around the Gesturi Plateau.

Another very large and potentially competing Nuragic system developed near the

Siddi Plateau on the well-known Gesturi Plateau located about 10 km to the northeast. The Gesturi Plateau is substantially larger than the Siddi Plateau, having an area of roughly 38 km², and its Nuragic settlements include Middle, Late, and Final Bronze Age sites, including the famous site of Nuraghe Su Nuraxi (Barumini-VS), located in the lowlands about 2.3 km from the southern border of the Gesturi Plateau (Image 25). It is possible that the clusters of Bronze Age occupation on and around the Siddi Plateau and the Gesturi Plateau indicate two Nuragic polities.

APPLYING THE PROPOSED MODEL TO THE SIDDI PLATEAU

Judging from the standing architecture and the limited archaeological work that has already been done, the Middle Bronze Age settlement system located on the Siddi Plateau provides an excellent opportunity for further research into the formation of social complexity on Sardinia. The differences in size and elaboration among the nuraghi on the plateau suggest that processes of competition among Nuragic incipient elites were taking place there during the Middle Bronze Age, with some incipient elites being more successful than others at motivating labor and attracting followers.

Excavations at sites with similar geologies, such as the project undertaken by the Universidad de Complutense de Madrid on the Muru Plateau 38 km away (Ruiz-Gálvez 2005), have recovered good pollen and environmental data, suggesting that the preservation of environmental data would also be good on the Siddi Plateau. The combination of archaeological remains indicating the social processes to be studied and the likelihood of good environmental data made the Siddi Plateau an excellent location for new fieldwork addressing the interaction among economic strategies, developing social complexity, and the local resource base during the Middle Bronze Age.

The goal of my new archaeological work was to use the proposed model as an explanatory tool for understanding economic behavior and environmental change. The Mediterranean is a fragile environment where the practice of some types of agriculture and animal husbandry has been known for decades to cause environmental change and resource degradation (Abahussain et al. 2002; Butzer 2005; Vasey 1992). Thus, the development of complexity in the Mediterranean provides useful case studies of

economic behavior in environments which are sensitive indicators of at least some kinds of unsustainable resource use. The early Nuragic culture on Sardinia provides many such potential case studies, and the development of social complexity on and around the Siddi Plateau, with its architectural suggestions of rapid growth followed by abandonment, is particularly suited to this inquiry.

Applying the proposed model to understand socioeconomic and environmental developments during the Middle Bronze Age on the Siddi Plateau required gathering new archaeological data in several categories. Evidence had to be gathered that would allow me to locate the Siddi Plateau along the axes of the proposed model – producer mobility and resource availability.

Producer Mobility

The four factors constraining producer mobility - geography, land improvements, violence, and population - all have archaeological correlates which can be understood to place the producers of the Siddi Plateau settlement system somewhere along a scale of greater or lesser mobility. First, a geological reconstruction had to be undertaken to determine whether any major changes in geography had taken place since the archaeological case study. Such a study would include factors such as erosion and the disturbances caused by any land-improvements that had taken place after the archaeological case study. Survey and excavation could reveal whether there had been land improvements. Excavation could also provide evidence about the level of violence in the area, including burning of buildings and villages, weapons, and human skeletons with indications of trauma. Finally, understanding population as a constraint required an environmental reconstruction of the area and an understanding of settlement patterns to get an idea of how densely the landscape was populated, as well as an understanding of subsistence practices.

Currently, there are no known non-elite settlements on the plateau, though Lilliu makes a reference to there being such a settlement (Lilliu 1988:335). There are also no known Nuragic villages in the area, with the exception of an Iron Age village surrounding Nuraghe Genna Maria in Villanovaforru, about 5 km to the south; this village is late

enough in date that labeling it Nuragic is debatable. Without associated villages, understanding population through numbers and sizes of houses is impossible. Changes in site sizes may help to understand population, though it will be important to keep in mind that these are changes in the sizes of elite sites, and will not be direct reflections of changes in population. Offsite artifact density may be the best way to understand changes in population for the Siddi Plateau settlement system; however, even this method may be complicated by the conservative nature of Nuragic ceramics and tools, making it difficult to assign them to a particular period within the Nuragic chronology.

Although other Nuragic elite sites are know in the area, all of these sites appear to date from the Late rather than the Middle Bronze age, and are unlikely to be contemporaneous with the occupation on the Siddi Plateau. Additional survey work was necessary to understand density of occupation in the area of the Siddi Plateau.

The defensive intent of nuraghi as an architectural form is debated, particularly that of corridor nuraghi, but the locations of the nuraghi on the Siddi Plateau suggest defensibility. The Siddi Plateau is very steep, making the elite sites on top of it highly defensible from attacks coming from the lowlands below. The threat of violence suggested by the sites' locations can be confirmed or refuted through excavation. Evidence for human skeletons with violent trauma is not likely to be available since Sa Domu 'e s'Orcu was disturbed in antiquity, but evidence for weapons or burning of sites may be recovered through excavation of the sites on the Siddi Plateau.

Subsistence Base

Understanding subsistence base was approached through excavation. Faunal remains, macrobotanical remains, pollen, phytoliths, and starches could all be recovered through excavation at the known elite sites. It is problematic that evidence for other types of subsistence patterns, such as those of producers or subsistence patterns at special purpose sites, cannot currently be recovered. While pollens from soils excavated at elite sites may give an indication of territorial use in the general area and give some indication of producer agricultural strategies, the rest of the evidence recovered at elite sites would reflect elite subsistence patterns, and would have little bearing on producer subsistence. If the elite pattern is one of generalized consumption of all available food resources, it may

be possible to hypothesize that producer subsistence included the same general mix of foods, if not in the same ratios. However, if elite subsistence appeared to be at all specialized, its utility for reconstructing producer subsistence would be low.

Resource Availability

Understanding resource availability was also approached through excavation of the elite sites on the Siddi Plateau. It is important to keep in mind that in a highly developed command economy, evidence for decreasing resource availability such as the consumption of less desirable crops or smaller game animals, fish, and shellfish as well as the use of less desirable woods for building or fuel may be masked at elite sites. If elites can command the best products regardless of their rarity or the difficulty of procuring them, a depletion of the resource base would be visible at producer sites long before it was visible at elite sites. This problem is exacerbated by the likelihood that processing activities did not take place at elite sites in highly developed political economies, making it difficult to recover weed seeds that might indicate soil depletion. However, these interpretive problems are less likely to affect an emergent political economy such as that of the Siddi Plateau settlement system, where the ability to command resources from producers was probably not highly developed.

It is therefore likely that if a change in the resource base was occurring during the occupation of the Siddi Plateau settlement system, evidence for it would be seen at the elite sites. Macrobotanical remains and microfossils from excavated soils should then be good indicators of soil quality, while wood charcoal and arboreal pollen and phytoliths should reflect changing use of timber resources, and faunal remains should indicate changes in the sizes or ages of wild animal resources.

Elite Strategies

Finally, evidence for many elite strategies was also recovered through excavation. Evidence for some, such as monumental building, low-cost status markers, and group-building ritual, was already known in the form of the corridor nuraghi and giant's tomb and the collection of votive ceramics found in the forecourt of the giant's tomb. Evidence

of feasting and raiding could be expected to be recovered if these strategies were also used, though again, any evidence involving human remains was not likely to be recovered. Other strategies, such as changes in agricultural production, the introduction of new wealth items, and craft specialization could be expected.

Unfortunately, evidence for some elite strategies could not be recovered for the settlement system of the Siddi Plateau given our current knowledge of the system. The lack of known Middle Bronze Age villages associated with the plateau precluded recovering direct evidence of a strategy of rewards to followers by excavating producer houses and identifying evidence of elite goods in producer contexts. The creation of a slave class would also be difficult to recover. Although it is possible that extremely poor assemblages might be identified in certain areas of elite sites, the corridor nuraghi generally have very little differentiation of space. If there were slaves living as part of the households of Middle Bronze Age leaders, evidence of their existence is likely to be mixed in with that of their masters.

NEW ARCHAEOLOGICAL INVESTIGATIONS OF THE SIDDI PLATEAU SETTLEMENT SYSTEM

Recovering the archaeological data necessary to apply the proposed model to the Nuragic community of the Siddi Plateau required the establishment of a new project aimed at excavating elite sites on the plateau and surveying the surrounding areas. Progetto Pran'e Siddi was established in April 2009 for just these purposes. Progetto Pran'e Siddi was a collaborative project run jointly by the University of Michigan and the Museo Genna Maria located in Villanovaforru, Sardinia. I directed the field operations of the project, and Mauro Perra, director of the Museo Genna Maria, served as the scientific director. Mario Vacca served as the project draftsman.

The project was designed to recover comparative data on elite strategies and relative success in labor capture by excavating areas of three of the nuraghi on the plateau and correlating the results with evidence of population change gained by surveying a sample of the lowlands associated with each nuraghe. The nuraghi chosen for excavation

were Sa Conca Sa Cresia, the largest nuraghe on the plateau, located in the north; Pranu Casti, the largest unexcavated nuraghe located in the south of the plateau; and Su Gruxi, a small nuraghe from the central part of the plateau, chosen for geographical reasons suggesting that intact deposits might have been preserved there (Image 28). Trenches at Sa Conca Sa Cresia and Pranu Casti were placed where there were indications of Nuragic architecture that was not so collapsed as to be impossible to access (the main chambers of all the nuraghi are completely collapsed and could not be excavated without extensive use of a crane). The trench at Su Gruxi was placed in a flat area next to the nuraghi likely to have been used as a work area.

Unfortunately, many of these trenches proved to be unhelpful in advancing my research. The trench at Su Gruxi yielded only a thin, sterile topsoil above a layer of weathered bedrock, suggesting that heavy erosion had removed any evidence of occupation that had once been there. The one interesting find at Su Gruxi was the discovery that the trench came down immediately on mudstone rather than on the basalt layer that usually caps the mudstone (see Chapter 5), indicating that Su Gruxi had probably been built with basalt quarried from its immediate area (Image 26).

Image 26: Bottom of the trench at Su Gruxi showing a few reamining basalt cobbles over a bed of mudstone. Photo E. Holt.

The trench at Pranu Casti likewise proved unhelpful in understanding Middle Bronze Age elite strategies. Although the indications of architecture did presage a buried structure (Image 27), the ceramic finds associated with the structure were strictly Late

Antique/early Medieval in date. Although the structure was excavated to a sterile soil layer, no evidence of Bronze Age occupation was recovered.

Image 27: Visible architecture and buried Late Antique/Early Medieval structure at Pranu Casti. Photos E. Holt.

Fortunately, the initial trench at Sa Conca Sa Cresia preserved almost 2 m of Middle Bronze Age deposits, which prompted me to excavate a second trench in another area of the site where there were indications of buried architecture. A detailed description of the excavations at Sa Conca Sa Cresia is given below.

Image 28: Locations of the three nuraghi that were the focus of new excavations.

The Excavations at Sa Conca Sa Cresia

Sa Conca Sa Cresia is a multi-tower nuraghe that shows evidence of several building phases. The east part of the nuraghe shows a straight, coursed wall suggestive of early corridor-style architecture, which may indicate that this is the oldest area of the nuraghe. The corridor structure backs up against two connected main chambers built in the false-tholos style (see Chapter 6) that may have been built at the same time as the corridor or may have been added onto it slightly later. The main chambers show a second phase of building in which a refacing wall in a different construction style was added. This refacing appeared to have been built to meet the foundation of an additional, external round structure, creating an enclosed courtyard between the external structure and the main adjoining towers, an interpretation which was confirmed by excavation. Other additional towers may also have been part of the refacing wall, though the collapsed state of the nuraghe makes them difficult to identify with certainty.

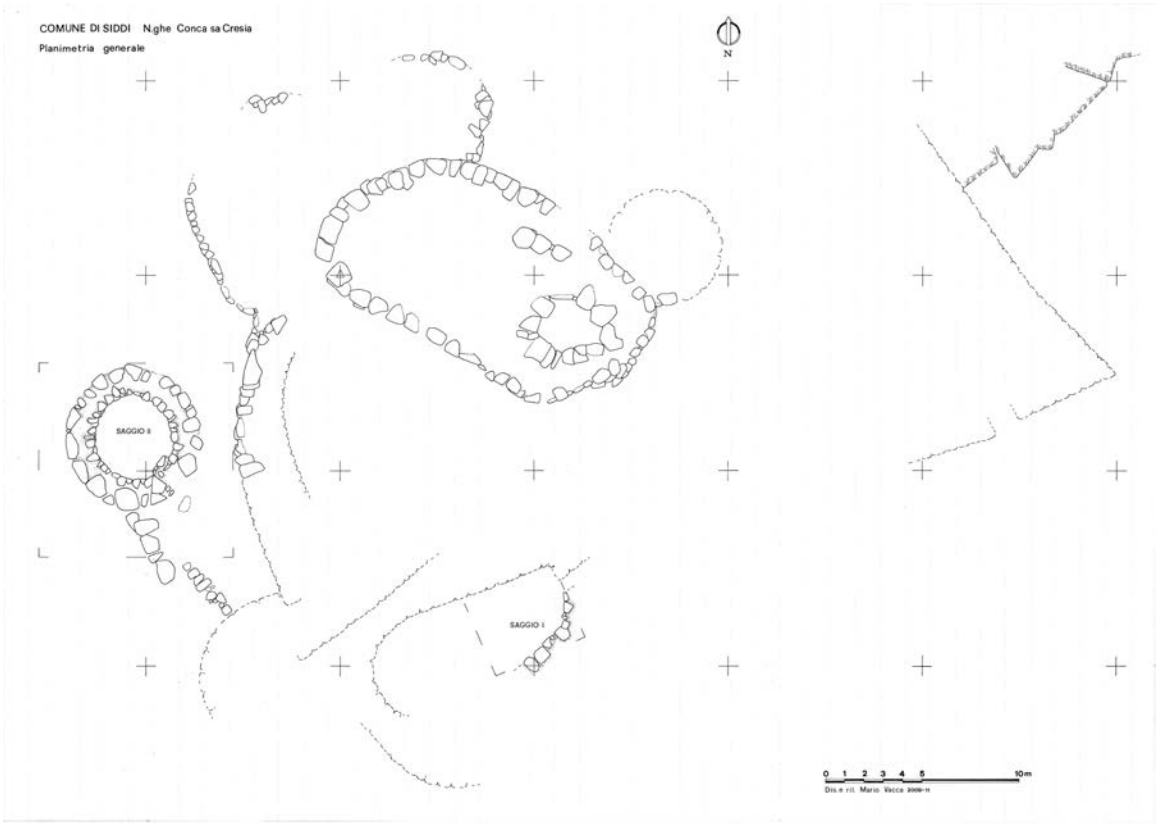


Image 29: Site plan of Sa Conca Sa Cresia showing the locations of Trench I (Saggio I) and Trench II (Saggio II). Drawing by M. Vacca.

The first trench at Sa Conca Sa Cresia was located in the corridor area on the east side of the nuraghe (see Image 29). The trench measured 3.5 x 4 m and was oriented northwest-southeast, following the direction of the corridor and extending as far as safely possible toward the edge of the plateau while still leaving space to work. This trench did not extend the entire length of the corridor, but was located so as to excavate about half of the corridor while maintaining access to the site and avoiding areas where excavation would have been dangerous. Even so, after excavating about 1 m of collapse deposits, it was decided that excavating immediately next to the corridor was too dangerous, and the trench was reduced to 2.5 x 4 m.

The second trench at Sa Conca Sa Cresia was located on the south side of the nuraghe, around the curved line of stones that indicated the presence of the buried external structure. The trench outline measured 5 x 5 m; however, only the inside of the round structure and a small section external to the structure were excavated. The results of both trenches are described in detail below.

Sa Conca Sa Cresia Trench I

Trench I (Image 30) provided the most information about Middle Bronze Age occupation at the site, showing a clear and mostly undisturbed stratigraphy from bedrock to abandonment. This stratigraphy could be divided into phases of activity on the basis of sediment types, deposition types, and finds. These phases were also dated using accelerator mass spectroscopy (AMS) radiocarbon dating of carbonized grains found in key stratigraphic contexts; details of the dates will be given in the discussion below. The abbreviations US ("*unita stratigrafica*" or stratigraphic unit) and USM ("*unita stratigrafica murale*" or architectural unit) will be used when discussing specific contexts and building activities; details about the nature of each unit and its stratigraphic relationship to other units in the trench can be found by referring to the Harris Matrix and Stratigraphic/Architectural Unit List in the Appendix.

Image 30: Opening shot of Sa Conca Sa Cresia Trench I. Several courses of the corridor wall are visible. Photo E. Holt.

Excavation Phase 1: Construction and Occupation of the Corridor Nuraghe

The construction of a corridor is the earliest phase of construction we have identified at Sa Conca Sa Cresia. The corridor was constructed in the Middle Bronze Age by filling gaps in the uneven basalt bedrock with hard-packed clay to level it and then constructing the corridor on top of this prepared ground using large blocks of the local basalt. Corridor nuraghi in Sardinia are typically constructed with a single corridor running through a massive rock platform with one or more small circular or sub-circular rooms coming off the corridor. The corridor may extend through the entire platform, creating two entrances, or may end in one of these small rooms. The corridors of corridor nuraghi are generally less than two meters in width and the small rooms only a few meters in diameter.

The corridor structure at Sa Conca Sa Cresia was only partially excavated, making the detailed understanding of the complete early structure impossible. However, much of the northwest side of the corridor is still visible above ground, and a rough description can be put together by projecting its mirror image. The corridor was probably 11m long

with straight sides, a curved, triangular entrance at the northeast end, and a small room with a diameter of three or four meters at the southwest end. Excavation revealed the construction technique to be somewhat unusual, with smaller blocks used near the bottom of the structure and larger blocks near the top. This construction technique was used elsewhere on the Siddi Plateau and was developed into a full false-tholos style which allowed the construction of tholos-like structures in which the vaulting was achieved not by balancing blocks against each other but by using large blocks that counterbalanced the weight over the vault with a greater amount of weight resting over the body of the structure (the technique was also used at Sa Fogaia). This false-vaulting seems to be unique to Siddi Plateau on the island of Sardinia.

The two main chambers of Sa Conca Sa Cresia, which also use the false-tholos vaulting construction technique, may have been built at the same time as the corridor or may have been built slightly later; it is impossible to be certain without excavating the main chambers themselves, which their collapsed state makes impossible without a large amount of funding and labor. The corridor of Sa Conca Sa Cresia was constructed and occupied for a short time before the southeast side was torn down and the northwest side incorporated into a new structure. Excavated layers associated with this phase are the culturally sterile, hard packed clay preparation layer (US 42), the northwest side of the corridor (USM 1), and a single clay occupation layer (US 39). Two carbonized grains recovered from US 42 have given radiocarbon date ranges of 1778-1606 cal BCE (88.7% probability) and 1831-1634 cal BCE (81.3% probability).

Excavation Phase 2: Construction and Occupation of the Naviform Room

Shortly after the corridor was constructed, the southeast side was torn down and the northwest side was incorporated into the construction of a large naviform room. Large amounts of cultural debris produced by the occupation of the corridor were dumped into the uneven bedrock to the south to level it. The cultural debris was not packed hard throughout like the clay foundation of the corridor, but was only packed near the surface. The wall of the naviform room was built on top of this preparation layer. The entrance to the new strcuture was left at the same place as the old, but the new wall curved outward instead of running straight like the corridor wall. It seems to have been built to join the

curve of the small room at the end of the corridor, creating a much larger living space. This space would have been impossible to roof with stone, indicating that it was probably roofed with thatch or wattle-and-daub.

After its construction, the naviform room was used intensively as a habitation. The associated deposits are a series of packed clay floors with baked hearths constructed on top of them and pottery and artifacts embedded in their surfaces. The first hearth, which is constructed directly on top of the cultural fill layer, is circular and located in the south-center of the excavated part of the naviform room. With each successive floor, the hearth becomes more oval in shape and migrates slightly southeast toward the wall. These floors, totaling eleven including the fill layer and a final, degraded living surface, sometimes have an associated ash pile on top of them. The floors are extremely fine, often only a couple of centimeters deep, and probably represent the frequent remaking of the living area by the occupants during a restricted chronological span.

The excavation of the naviform room was made difficult by a later wall constructed through the room which divided the excavated area into two parts. It was much easier to differentiate floors in the part of the trench that contained the hearths (southeast), where the hearth construction itself as well as embedded pottery and artifacts indicated floors levels. It was frequently impossible to differentiate between floors in the part of the trench that did not contain the hearths (northwest).

Excavated layers associated with this phase on the southeast side are the leveling fill (US 47), the wall of the naviform room (USM 2), a series of floors (US 46, US 45, US 44, US 41) and an ash deposit on top of US 41 (US 40), another series of floors (US 38, US 36, US 34) and an ash deposit on top of US 34 (US 32), a final series of floors (US 30, US 26) and the ash deposit on top of US 26 (US 22), a degraded living surface (US 24), and a shallow occupation fill (US 20).

Excavated layers associated with this phase on the northwest side are a series of arbitrarily defined clay layers that correspond to the floors on the southeast side but in which separate floors could not be distinguished (US 37, US 35, US, 31, US 29, US 28), and a shallow occupation fill that corresponds to US 20 on the southeast side of the trench (US 25).

Two radiocarbon dates from two carbonized grains recovered from the

construction layer US 47 gave ranges of 1783-1621 cal BCE (80.5% probability) and 1681-1491 cal BCE (91.8% probability). One radiocarbon date from a carbonized grain recovered from the earliest hearth (US 40) gave a range of 1749-1502 cal BCE (95.4% probability). Finally, a carbonized grain from the latest hearth in Phase 2 (US 22) gave a radiocarbon date range of 1687-1497 (95.4% probability).

It is important to note that there is some disagreement about the reality of Phase 1 as a separate phase from Phase 2. I interpret the two phases as separate based on the extremely different ground preparations used before construction (hard-packed near-sterile clay in Phase 1, suggesting a fresh occupation of the area, versus very loose midden fill in Phase 2, suggesting that the area had been occupied long enough for the inhabitants to create a midden), the differently sized blocks used to build USM 1 and USM 2, the straightness of USM 1 versus the curved shape of USM 2, and the lack of symmetry in the entrance arch formed by USM 1 and USM 2, which is not typical of Nuragic structures and suggests two separate buildings phases. However, my colleague Mauro Perra does not consider this evidence strong enough to indicate two separate building phases. In his assessment of the phases at the site, Phase 1 and Phase 2 are a single phase, and the space began as a naviform room, not as a corridor. It is also possible that the Nuragic inhabitants of the site initially intended to build a corridor that was never completed, and then decided to finish the construction as a naviform room, which would also account for the differences in ground preparation and architecture. The radiocarbon dates for Phase 1 and Phase 2 mostly overlap, and fortunately, definitely knowing whether there was a completed corridor, the intent to build a corridor that became a naviform room, or simply a naviform room does not bear on the interpretation of subsequent human activity at the site.

Excavation Phase 3: Metalworking Phase

After the series of occupations of the naviform room, the habitation of the room was abandoned and the room appears to have been used as a dumping area for industrial refuse, probably from metalworking. The fills of this phase consist of a vitrified sediment indicating extremely high temperatures (Image 31). This sediment is frequently white in color, but can also be gray, reddish, or yellowish, probably caused by various minerals in

the ore or fuel used to work the metal. Animal bones found in these layers were frequently stained green, indicating the presence of copper. A bronze working industry seems a likely explanation for what produced the waste dumped into the naviform room during this phase, and the sediment is probably processed copper ore.

Image 31: Surface (left) and profile (right) of light-colored layer of superheated copper ore sediment. Photos E. Holt.

Excavated layers associated with this phase are US 23, US 21, US 18, US 13 on the northwest side of the trench and US 17 on the southeast side.

Excavation Phase 4: Building of the Internal Wall

The use of the naviform room changed again after the industrial phase. On the northwest side of the trench there is evidence for a packed clay floor that was hardened and turned red through exposure to heat. There is no evidence for this floor on the southeast side of the trench, and the floor appears to have been mostly destroyed before the next layer was laid down. This next layer was a packed clay foundation on which the internal wall was built. The building of the internal wall represents a major change in the organization of the space. The internal wall subdivides the space and also blocks the former entrance to the corridor/naviform room. Whether and where a new entrance was constructed, or whether the new space was entered from above, cannot be determined on

the basis of the excavated area.

There was a small pile of compact ash on top of the foundation layer perhaps indicating a short occupation before the wall was built. Also, shortly after the internal wall was built, it was partially dismantled to create a lower platform near the blocked former entrance. This platform was used as the base for a hearth which appears to be associated more closely with the southeast part of the trench than the northwest part. The fill of the southeast part of the trench is highly ashy and extends up to the height of the hearth. The stratigraphically comparable fill on the northwest side of the trench is a compact clay occupation layer with no ash in it.

Excavated layers associated with this phase on the southeast side of the trench are the clay foundation layer (US 16), the ash deposit on top of this clay foundation layer (US 12), the internal wall itself (USM 3), the dismantling of part of the internal wall to create the hearth platform (USM 4), the hearth itself and its associated ash deposit (US 10), and the ashy fill surrounding the hearth and ash deposit (US 9). On northwest side of the trench the excavated layers associated with this phase are the partially destroyed floor (US 15), the clay foundation layer of the internal wall which corresponds to US 16 on the southeast side (US 11), and the clay occupation layer (US 8).

A radiocarbon date from a carbonized grain recovered from the latest hearth in Phase 4 (US 10) gave a range of 1619-1386 cal BCE (95.4% probability).

Excavation Phase 5: Abandonment of the Naviform Room

This phase seems to follow quickly on the heels of the building of the internal wall. Clay layers with large amounts of burned daub suggest that the room may have been roofed with wattle and daub or had wattle and daub walls built on the stone walls for foundations. These appear to have burned down whether intentionally or accidentally and been thrown into the room with clay to level the space. The naviform room may have been put out of use intentionally due to topography problems. The naviform room was built very near the edge of the plateau. It is possible that the space was much larger in antiquity, but subsequent erosion and collapse reduced the space and may also have made the naviform room either inconvenient or dangerous to use. The filled-in space may have had other purposes, such as a workspace.

Excavated layers associated with this phase are US 4 and US 4.1 (later determined to be the same) on the northwest side of the wall and US 5 and US 7 (later determined to be the same) on the southeast side of the wall.

Excavation Phase 6: Collapse of the Nuraghe

Some time after the naviform room was filled in, the entire nuraghe was abandoned and began to collapse. This is likely to have occured several centuries after the abandonment of the naviform room. The latest pottery associated with the naviform room was Late Middle Bronze Age/Early Late Bronze Age. However, the latest pottery found in the collapse layers was Punic/Roman. This does not necessarily imply that occupation of the site was continuous or that the inhabitants of the site continued to be culturally "Nuragic" simply because they were living in a Nuragic structure. However, it does strongly suggest that active use of the nuraghe continued for some time after the naviform room was put out of use, and that the Punic/Roman period inhabitants of the site found much of the architecture still standing and usable, at least for a time.

An Italian coin dating to 1941 was also found in the upper part of the collapse layers, indicating that the structure probably experienced multiple episodes of collapse; however, these episodes could not be distinguished during excavation.

Excavated layers associated with this phase are US 3 and US 2, the distinction between which is arbitrary.

Excavation Phase 7: Modern Use

This phase documents the continued frequenting of the site by modern Sardinians. Finds include numerous shotgun shells, the key from a sardine-type metal can, a metal buckle, a plastic button, and additional fragments of plastic.

The excavated layer associated with this phase is US 1.

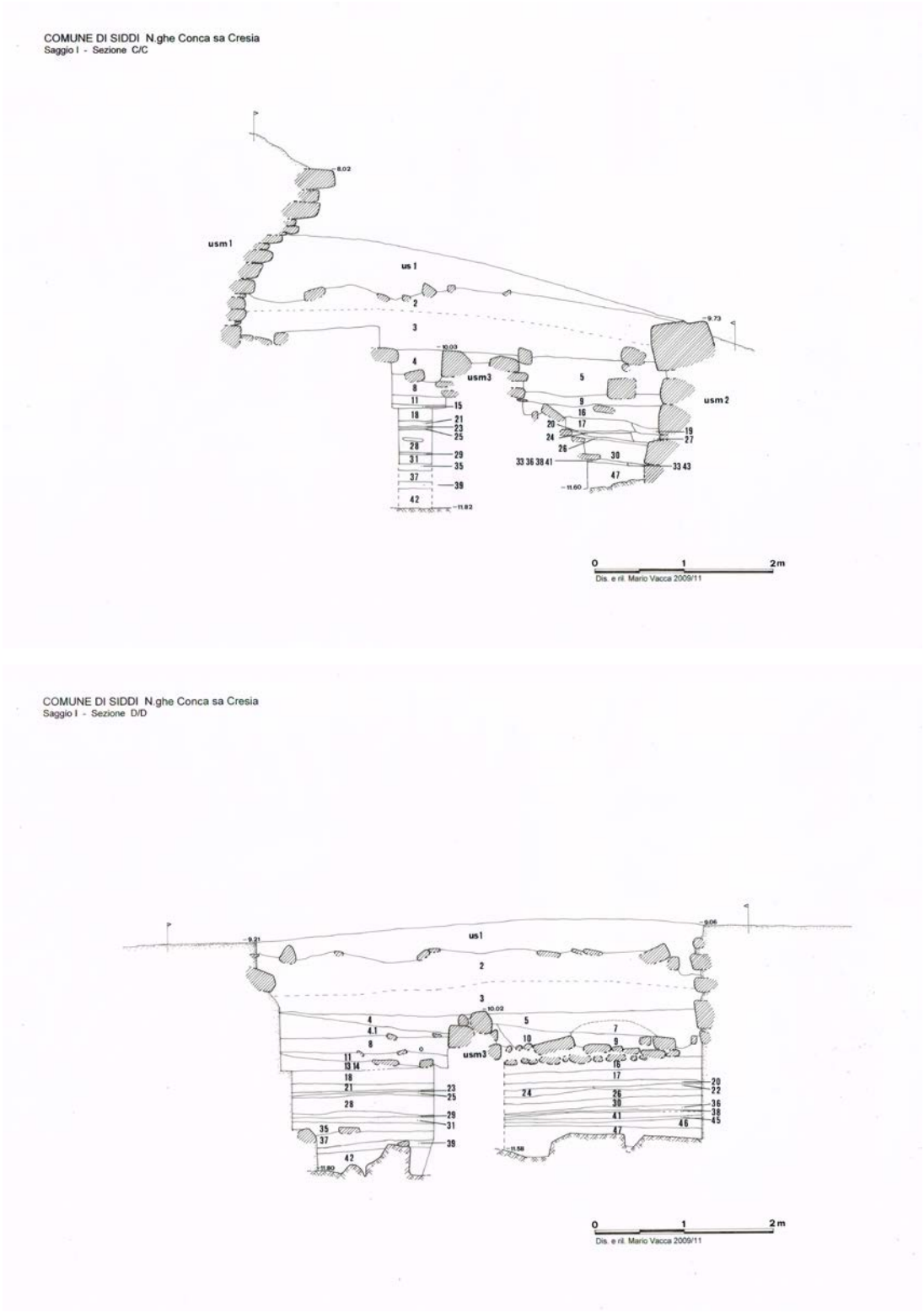


Image 32: Sa Conca Sa Cresa Trench I sections: northeast-southwest (top) and northwest-southeast (bottom). Drawings M. Vacca.

Sa Conca Sa Cresia Trench II

Unfortunately, Trench II did not produce evidence of Nuragic occupation. Excavation did reveal a buried round structure, which may originally have been a small tower or hut (Image 33). A tower seems the more likely explanation, given the very large size of the foundation stones at the bottom of the structure, which are much more massive than stones usually used in Nuragic hut-building. There is a relative absence of collapse around the tower, which may indicate that the structure was never completely finished; however, the site also has a long occupation history evidenced by walls and structures built by shepherds in the modern period, and it is also possible that the building stones from the collapsed structure have simply been reused. The round structure was connected to the main nuraghe by two walls, some of the stones of which remain in place, and excavation revealed that the entrance to the round structure was from inside this enclosed area. Protected courtyards of this type are common features of complex nuraghi.

Although five stratigraphic layers could be distinguished inside the round structure, it was clear from the associated pottery that the site had been reoccupied in the Punic/Roman period and all layers except the foundation layer dated to this reoccupation. The later occupants cleared the site down to its foundation before inhabiting the structure with the result that, although a large amount of Middle Bronze Age pottery was found during the excavation, the Nuragic materials must be considered residual and only the Punic/Roman materials are in stratigraphic sequence. The one exception is a single Middle Bronze Age sherd that was pulled from the hard-packed clay fill that was used to level out the uneven bedrock and form a foundation layer. This clay foundation layer was otherwise culturally sterile.

Image 33: Closing shot of Sa Conca Sa Cresia Trench II showing the basalt bedrock on which this subsidiary tower was built. The tower entrance, in the upper right of the photo, lead into an enclosed courtyard. The wall of Sa Conca Sa Cresia's main tower is visible in the background. Photo E. Holt.

Survey

The survey component of this research was intended to provide comparative data for density of occupation and intensity of land use that could be correlated with evidence of successful elite strategizing, measured through labor capture over time at each of the excavated nuraghi. However, as no artifacts that could construct a chronology and give evidence of changes in production/consumption were recovered at Su Gruxi and the nuraghe appears to have been built in a single episode, Su Gruxi was eliminated as a candidate for survey. Pranu Casti also presented problems since excavations there did not yield any Nuragic period stratigraphy; however, the nuraghe itself shows evidence for at least two episodes of construction: the main chamber and a refacing wall around it that

was overbuilt to create a platform that provided extra elevated living space (similar design and construction techniques were used at Sa Fogaia). Sa Conca Sa Cresia provided the best candidate for survey since it yielded a detailed stratigraphic chronology with associated artifacts and has evidence of at least three building episodes (corridor and main chambers, refacing wall, external tower and courtyard). In the end, a sample of the lowlands near both Sa Conca Sa Cresia and Pranu Casti was surveyed.

Areas for survey were selected from a catchment with a 500 m radius around each of the two nuraghi. Areas of the catchment that fell on the plateau were considered unsuitable for survey because the goal of the survey was to recover information about lowland activities associated with each of the nuraghi. The lowland areas selected for survey were somewhat limited as only plowed fields could usefully be surveyed; much of the land around the Siddi Plateau is scrubby pasturage with low visibility and very few surface artifacts. An attempt was made to select several plowed fields that represented as much as possible of the territory surrounding the nuraghi; however, the fields surveyed are not a random sample of the nuraghi's territories. A total sample of 27,468 m^2 was surveyed around Sa Conca Sa Cresia and a total sample of 29,018 m^2 was surveyed around Pranu Casti.

Fields were surveyed by walking transects at 5 m intervals. All observed artifacts and artifact clusters were recorded as GPS points; artifact clusters were defined as groups of artifacts concentrated within a radius of 10 cm, and were usually groups of obsidian fragments. Unfortunately, this survey encountered the same often-remarked problem that many surveys in Sardinia have encountered: Nuragic pottery is quite conservative and can often not be dated with confidence other than being identified as Nuragic. Obsidian tool types face the same problem, and while some are identifiably either Neolithic or Nuragic, most can belong to either period. Additionally, some use of obsidian continued after the Nuragic period into the Iron Age and the period of Punic/Roman influence. Although most obsidian finds are probably due to Neolithic/Eneolithic/Nuragic activity, some may have been produced by later, Punic/Roman period activity. Finally, some ground stone tools such as axes and mace heads (*teste di mazza*) can be identified as Neolithic or Nuragic, but others such as grinding stones and pestles change little over time.

Field CSC 1

Field CSC 1 was a freshly-plowed field with almost no ground cover, allowing for high visibility of artifacts. It was a total of 17,105 m² in area and had a 20° slope at 160°. A total of 54 artifacts or artifact groups were found in this field, giving an overall artifact density of 1 artifact every 317 m². Only three of these artifacts could confidently be dated to the Bronze Age: two Nuragic sherds (Image 34) and a wedge-shaped piece of worked basalt of the kind often used to fill chinks in nuraghi. The worked basalt probably fell into the field from the plateau above, so only the two Nuragic sherds can be considered indications of Nuragic frequentation of the lowlands in this area. At 1 Nuragic artifact per 8553 m², this field had the second lowest density of Nuragic artifacts of any field surveyed. However, artifacts in this field included a very large number of worked basalt artifacts: 13 grinding stones, 6 quern fragments, a possible mace head fragment, and a round piece of worked basalt that may have been a jar stopper. While only the mace head fragment has a high probability of being Nuragic rather than Neolithic/Eneolithic, all of these artifacts represent types that were made and used during the Nuragic period. It is important to consider the possibility that Nuragic frequentation of this area may have been greater than indicated by the pottery alone. Calculating the density of Nuragic artifacts including the macehead fragment gives a density of 1 per 5702 m.

The large number of worked basalt artifacts in this field is in contrast to the very low density of obsidian found in it, which seems to confirm that this area was not commonly frequented before the Punic/Roman period. The basalt artifact types found in this field – primarily grinding stones and saddle querns – are very conservative; it is possible that many of the basalt artifacts found in this field date to later Punic/Roman period occupations. Secure Punic/Roman period artifacts, which are all sherds, give a density of 1 artifacts per 1140 m², a much higher density than the range indicated for Nuragic artifacts.

Image 34: Survey results from Field CSC 1

Field CSC 2

Field CSC 2 was a freshly plowed field with almost no ground cover except around the edges. It had a 7° slope at 200° and was total of 1,476 m² in area. A total of 25 artifacts were found in the field, giving an overall density of 1 artifact per 59 m². None of the artifacts found in this field could be securely identified as Bronze Age, the lowest density of Bronze Age Artifacts in any field surveyed. Two basalt grinding stones and three quern fragments were found in this field, but could come from a wide range of time periods. The sporadic obsidian finds in this field may suggest some frequentation of the area in the Nuragic period (Image 35), but could just as easily relate to activity in the Neolithic or Eneolithic.

There were four confidently datable Punic/Roman period artifacts in this field, giving a density of 1 artifact per 369 m². This is the second highest density of Punic/Roman artifacts encountered during the survey.

Image 35: Survey results from Field CSC 2

Field CSC 3

Field CSC 3 was a recently plowed field with very little ground cover. However, it was also very roughly plowed with a long-bladed plow, and the large clods of dirt this created (often 40 cm in length) decreased the overall visibility in the field. Field CSC 3 had a 25° slope at 310° and was a total of 1,505 m² in area. A total of 16 artifacts were found in this field, giving an overall density of 1 artifact per 94 m². Three of these artifacts were Nuragic sherds (Image 36), giving a density of 1 per 502 m² for securely-datable Bronze Age artifacts. This is the highest density of Bronze Age artifacts in any of the fields surveyed, which may relate to the field's nearness to Sa Conca Sa Cresia. It is possible that the sherds may have eroded from the site above.

Only one securely datable Punic/Roman sherd occurred in this field, giving a density of 1 artifact per 1505 m². This is one of the lower densities of Punic/Roman artifacts encountered during the survey.

Image 36: Survey results from Field CSC 3

Field CSC 4

Field CSC 4 was a fallow field that had recently been used for pasturage with moderate active ground cover and some dry grass and weeds obscuring visibility. Overall, the visibility of the field was considered moderate. The field had no appreciable slope and was a total of 7,382 m² in area. A total of 85 artifacts and artifact groups were found in Field CSC 4, giving an overall artifact density of 1 per 87 m². A total of six Nuragic sherds were found in Field CSC 4 (Image 37), though two were found side-by-side and were counted as a single artifact group. This gives a density of 1 per 1476 m² for securely-datable Bronze Age Artifacts. This is one of the lower densities of Nuragic artifacts found during survey, which is somewhat surprising given the Field CSC 4 is also located almost immediately below Field CSC 3, and could be expected to have a similarly high density of Nuragic finds. However, the field did contain one basalt mace head, which is probably Nuragic, and a high density of artifacts that cannot be dated securely but are likely to date to the Nuragic period: 4 basalt grinding stones and 3 pieces of worked basalt. It is likely that not all of these stone artifacts are Nuragic – grinding stones in particular are utilized throughout Sardinian prehistory and could date to almost any period. If the mace head, which is likely to be Nuragic, is included in the calculation, the density of Bronze Age artifacts increases to 1 per 1230 m². It makes sense to think of

the density of Nuragic artifacts in Field CSC 4 as being within a possible range, with 1 per 1230 m² being the lowest end of the range. The large amount of obsidian in the field, including some fine worked pieces, may also suggest more intense Nuragic frequentation, though again, obsidian is likely to indicate Neolithic/Eneolithic activity and may even relate to Punic/Roman activity.

Twenty-one securely datable Punic/Roman sherds were found int his field, giving a density of 1 per 352 m² for Punic/Roman artifacts. This is the highest density of Punic/Roman artifacts found on the survey. Given the known Punic/Roman reoccupation at Sa Conca Sa Cresia and the location of this field downslope from the nuraghe, some of these sherds may have fallen into the field from above.

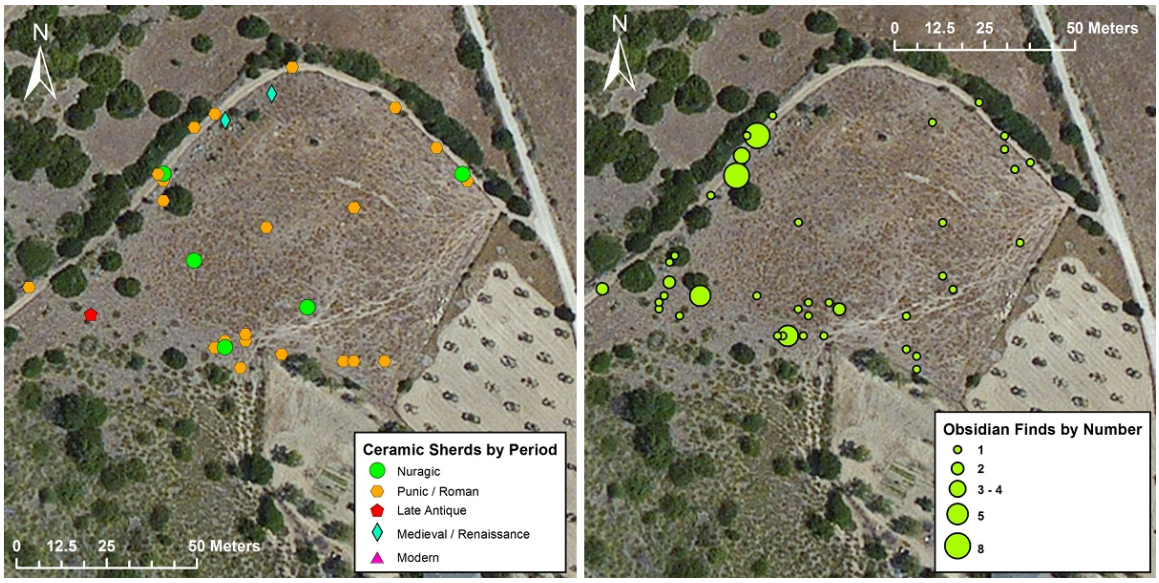


Image 37: Survey results from Field CSC 4

Field PC 1

Field PC 1 was a fallow field in the process of being replanted. It had recently been mowed and the cut weeds collected, so there was little active growth and a lot of bare patches. Overall, visibility was good. The field had a slope of 3° at 20° and was a total of 16,038 m² in area. This field was extremely dense with artifacts. A total of 214 artifacts and artifact groups were found in Field PC 1, giving an overall density of 1 per 75 m². Only four Nuragic sherds were found in this field (Image 38), giving a density of 1

per 4010 m² for securely-datable Bronze Age artifacts. One unfinished mace head fragment probably also dates to the Nuragic period, giving a density of 1 per 3208 m². A number of groundstone artifacts, primarily in basalt but also in imported stones, may indicate greater Nuragic frequentation: 7 grinding stones, 3 pieces of worked basalt, and 1 quern fragment. Even considering the possibility that some of these stone artifacts are Nuragic, this field had a low density of Nuragic artifacts in terms of the results of this survey. However, the high density of overall artifacts suggests a heavily frequented area. Many of the artifacts in this field were obsidian or other non-local lithic raw materials such as red granites, cherts, and quartz river pebbles; the emphasis on a variety of lithic industries suggests that perhaps this area was a site of intense Neolithic or Eneolithic use.

A total of 20 Punic/Roman sherds were found in this field, giving a density of 1 per 802 m² for Punic/Roman artifacts.

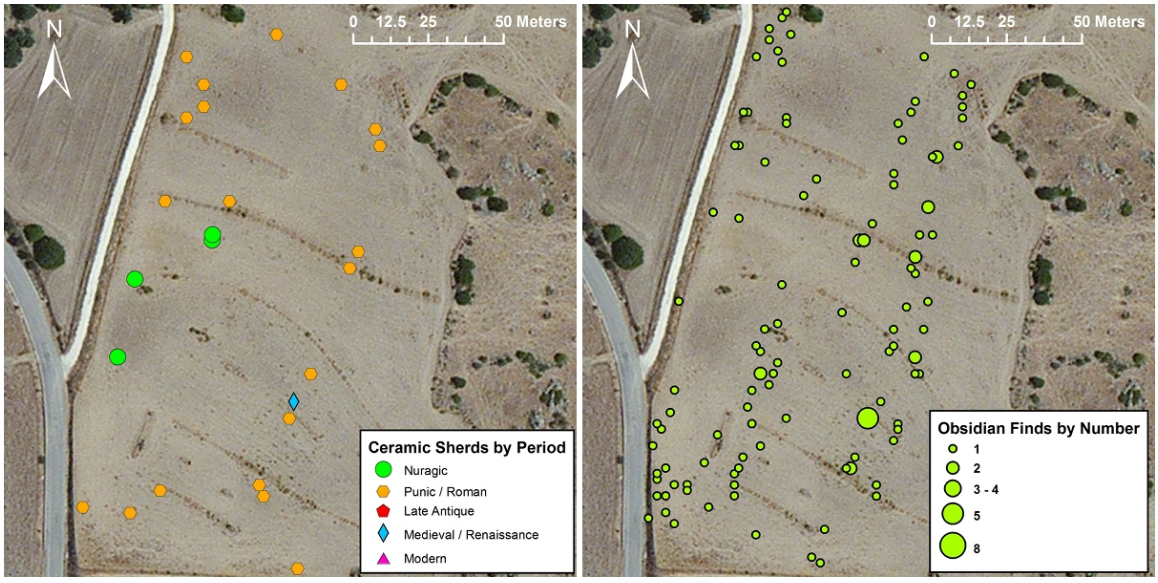


Image 38: Survey results from Field PC 1

Field PC 2

Field PC 2 was a recently plowed field with little active growth and good visibility. It had a slope of 12°-15° at 140° and was a total of 6,740 m² in area. A total of 174 artifacts and artifact groups were found in Field PC 2, giving an overall density of 1 artifact per 39 m². Eleven Nuragic sherds were found in Field PC 2 (Image 39), giving a

density of 1 per 613 m² for securely-datable Bronze Age artifacts. One basalt quern fragment and a red granite grinding stone were also found in this field, which could date to the Nuragic period. A density of 1 per 613 m² represents the second-highest density of Bronze Age artifacts found during the survey.

Similar to Field PC 1, Field PC 2 also suggests heavy Neolithic/Eneolithic frequentation. Again, many of the artifacts found in this field were non-local lithic raw materials including cherts, yellow and red granites, quartz river pebbles, and cobbles of a fossil limestone. The origins of the fossil limestone have not yet been determined, but it is not local to the Siddi area. Additionally, this field yielded the only securely identifiable Neolithic artifact, a fragment of a fine axe made of a red mudstone. The combination of the non-local raw materials and the axe suggest Neolithic activity in this area.

Finally, twelve Punic/Roman sherds were found in this field, giving a density of 1 per 562 m².

Field PC 3

Field PC 3 was a recently plowed field with mild to moderate active growth that was surveyed immediately after heavy rains that had encouraged new growth to sprout. Visibility was considered moderate to good. The field had a slope of 5°-7° at 100° and was a total of 4,113 m² in area. A total of 99 artifacts and artifact groups were found in Field PC 3, giving an overall density of 1 artifact per 42 m². Two Nuragic sherds were found in Field PC 3 (Image 39), giving a density of 1 per 2056 m² for securely-databled Bronze Age artifacts. This is a surprisingly low density given that Field PC 3 is adjacent to Field PC 2, which has one of the highest densities of Nuragic artifacts in the survey. Two basalt grinding stones were found in this field, which may date to the Nuragic period.

The suggestions of Neolithic/Eneolithic activity in this area were also strong in Field PC 3. The field yielded many finds of non-local lithic raw materials, including cherts, red and pink granites, fossil limestone, and quartz river pebbles. It also yielded a projectile point which is likely to be Neolithic, but cannot be dated with certainty. Finally, two Punic/Roman sherds were found in this field, giving a density of 1 per 2057 m², equal to that of the securely datable Nuragic artifacts.

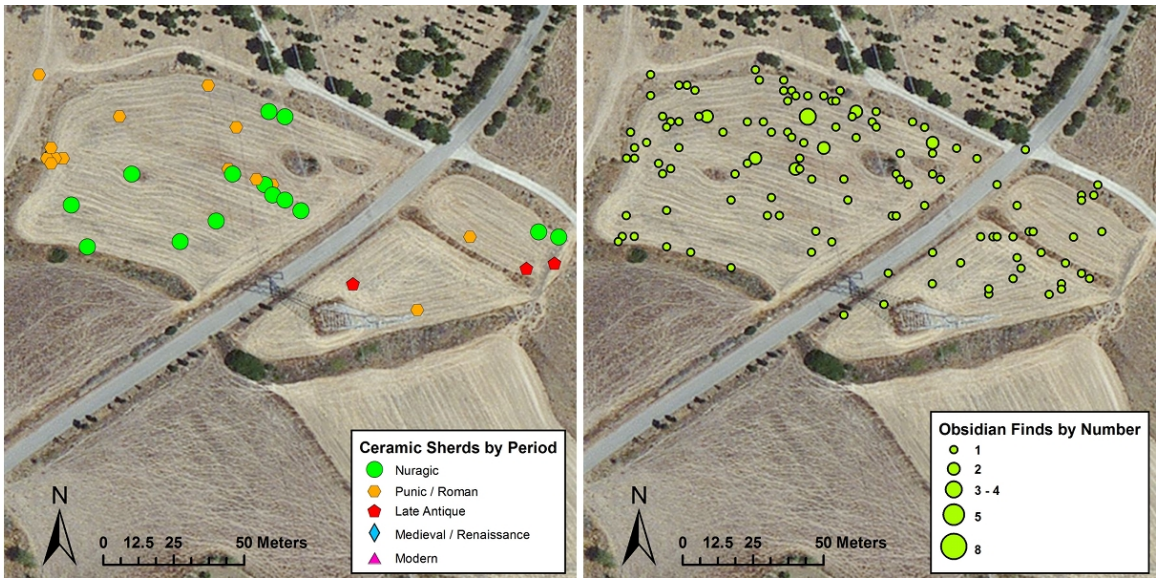


Image 39: Survey results from Fields PC 2 (north of road) and PC 3 (south of road)

Field PC 4

Field PC 4 was a recently plowed field with some freshly-sprouted ground cover and good overall visibility. The field had a slope of 5° at 140° and was a total of 2,127 m² in area. A total of 142 artifacts and artifact groups were found in Field PC 4, giving an overall density of 1 artifact per 15 m². No Nuragic sherds were found in Field PC 4, meaning that Nuragic frequentation of this area cannot be demonstrated. One piece of worked basalt was found in this field, which may possibly be Nuragic in date. Very unusually, no sherds of any date – Punic/Roman, Late Antique/Early Medieval, or Renaissance/Early Modern – were found in this field.

The heavy obsidian scatters (Image 40) indicate that this area was frequented, however. Like the other PC fields, Field PC 4 yielded numerous finds of non-local lithic raw materials, suggesting that the dense lithic scatters indicate Neolithic/Eneolithic occupation.

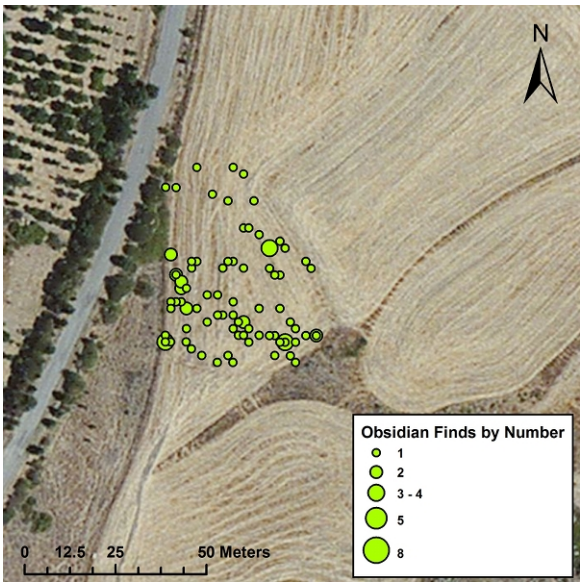


Image 40: Survey results from Field PC 4. No sherds were found in this field.

Conclusions of the Survey

Overall, the survey suggests a low-intensity but pervasive use of the lowlands by Nuragic people. Densities of securely datable Nuragic artifacts vary among fields and no clear geographical pattern emerges. Evidence for occupation in general is greater in the Pranu Casti survey area, which has much denser distributions of obsidian and other non-local lithic raw materials. This area does seem to have been more densely occupied than the Sa Conca Sa Cresia survey area, though this occupation is likely to relate to the Neolithic or Eneolithic rather than the Bronze Age.

In five fields the density of Punic/Roman artifacts was higher than the density of securely datable Nuragic artifacts, and in two fields the densities were equal (Fields PC 3 and 4). The Nuragic density was higher than the Punic/Roman density in only one field (Field CSC 3). This indicates either a higher-intensity of use of these lowland areas by people during the Punic/Roman period or a greater use of pottery during this time. Both conclusions are possible and they are not mutually exclusive: population growth between the Nuragic period and the Punic/Roman period would make a higher-density occupation of the landscape in the later period likely while the widespread availability of imported Punic and Roman pottery may have meant that more people had more pottery to use.

CONCLUSIONS

The new fieldwork on the Siddi Plateau did not prove as fruitful as I had hoped. I was not able to do the comparative part of my research design because only one of the nuraghi yielded well-stratified layers. The survey also did not prove as fruitful as I had hoped, though it did indicate constant, low-level frequentation of the lowlands during the Nuragic period. I was able to identify that the lowlands to the southeast of the plateau near the site of Pranu Casti were the location of considerable occupation; however, this occupation was indicated primarily by lithic artifacts, making it impossible to tell how much dated to the Neolithic and Eneolithic and how much to the Bronze Age. Additionally, I did not find ceramics diagnostic enough to distinguish between Middle and Late Bronze Age occupation in any of the fields surveyed. Nuragic occupation in the area around Pranu Casti in particular may be more associated with the Late Bronze Age occupation in the lowlands south of the Siddi Plateau (see Image 25) than the Middle Bronze Age occupation on top of the plateau.

The lowlands to the northeast of the plateau, near Sa Conca Sa Cresia, did not appear to be the site of much occupation. The one surveyed field that produced a large number of finds is probably an artifact of the erosion of the site immediately above it and not an indication of high levels of occupation. The other surveyed fields were noticeably sparse in artifacts. It is possible that this side of the plateau was not frequented because it is the side facing the settlement system of the Gesturi Plateau, the Siddi Plateau's most likely rival and a possible source of violent raids.

Fortunately, the excavation of Trench I at Sa Conca Sa Cresia did provide detailed information about elite production and consumption activities as well as sources of information about climate and environment in the Siddi area, information that can be related to the concepts developed in Section I of this dissertation. I will evaluate the results of the excavation of Sa Conca Sa Cresia Trench I using my proposed model in the following chapter.

Chapter 8: Social Complexity, Resource Use, and Environmental Change in the Middle Bronze Age Community of the Siddi Plateau

INTRODUCTION

My archaeological investigation of the Siddi Plateau yielded useful data for the interpretation of occupation at the site in terms of the model proposed in Section I of this dissertation. This chapter will begin by discussing the evidence for the key components of the model individually; I will first treat the evidence for the site synchronically, to provide a general understanding of the evidence for each of the key components of the model. I will then analyze, synthesize, and discuss all of the available evidence diachronically in light of the elite strategies and environmental outcomes predicted by the model. The goal of this chapter is to locate the political and economic development of the complex society of the Siddi Plateau within the model, and then to use this interpretation as a point of comparison for understanding potential trajectories of political and economic development in the Nuragic culture.

The first section of this chapter will compare the archaeological evidence from the Siddi Plateau area in three general phases corresponding to one or more excavation phases: the earliest habitation and use of the Nuragic sites on the plateau (Excavation Phase 1, see Chapter 7), the habitation of Sa Conca Sa Cresia before the metalworking phase (Excavation Phase 2), and the habitation of Sa Conca Sa Cresia including and after the metalworking phase (Excavation Phases 3-5). Within these groupings, two excavation phases are particularly comparable. Excavation Phase 2 and Excavation Phase 4 are both occupation phases consisting of floors and hearths. As such, the deposition and preservation processes in these two phases were likely to be similar. The one possible problem with this interpretation is the fact that the space was subdivided by a wall in Phase 4, which may indicate a change in the function of the space from what it was used

for in Phase 2. While many categories of evidence produced very few examples, making it necessary to group the results from excavation phases in order to discuss change over time, pottery sherds and faunal remains were numerous enough to allow comparison specifically between Excavation Phase 2 and Excavation Phase 4. For this reason, pottery and faunal remains will be analysed in detail below before proceeding to a general diachronic discussion of occupation at Sa Conca Sa Cresia.

CERAMICS AT SA CONCA SA CRESIA

Approximately 20,000 sherds were found in stratigraphic context during the excavations of Progetto Pran'e Siddi. Due to time and personnel limitations, only a small sample of these ceramics could be studied for the current work. The large majority of the excavated sherds are fairly undiagnostic body sherds, which are frequently difficult to assign to a vessel category and which can often only be studied for fabric, temper, wall thickness, and thoroughness/technique of firing. While understanding changes in these variables can certainly add to our understanding of economic activity at the site, it was decided to focus the preliminary study only on diagnostic sherds that could be more directly informative about the elite activities in the proposed model of political economy and resource use: accumulation and storage of goods, feasting, and elite identity building.

The preliminary ceramics study was limited mostly to rim sherds, which can be assigned with confidence to a category of vessel. Although actual daily use of ceramic vessels was probably varied and individual vessels may have been used for a variety of functions at different times, Nuragic ceramics can be divided generally into three categories: cookware, serving wares, and storage jars. Cookwares are mainly made up of the particular vessel known as the *coppa di cotura* (pl. *coppe di cotura*), or "cooking cup," which is a large, upside-down bowl with a rounded bottom that would be placed over foods to be baked and then have hot coals piled on top of it. Other, smaller vessels with rounded bottoms were also occasionally used as cooking vessels, though they could be used as serving vessels as well. For this preliminary ceramics study, all rim sherds of *coppe di cotura* were considered to be cookwares, while rim sherds of other open forms that could potentially have been used for cooking were classified as cookwares if they

had clear signs of soot or fire discoloration on their outsides.

Many Nuragic vessel shapes are serving wares: bowls (*scodele*), carinated bowls, carinated cups (*tazze*), plates (*tegami*), and jugs. Serving vessels are fairly easy to identify by their rim shapes; however, some serving vessel types such as bowls and carinated bowls are sometimes used for cooking, as indicated by soot marks and heat discoloration on their bottoms and sides. For this study, serving vessel shapes were assumed to have been used primarily as serving vessels and have been counted as serving vessels unless the presence of soot marks or heat discoloration indicates that they were frequently used for cooking.

Storage jars of various sizes are also common on Nuragic sites. They are easily distinguished by their characteristic rim shapes and rarely show signs of having been used for cooking, their large size and closed shapes probably having made them inconvenient as expedient cooking vessels. Rim sherds that could be identified as coming from jar-shaped vessels were always categorized as storage jars.

Finally, some vessels of a variety of serving shapes were categorized as "fine wares." Fine wares were characterized by their thin walls (always less than 0.7 cm and generally less than 0.4 cm) as well as their well-levigated and minimally-tempered fabrics, generally high firing temperatures, and sometimes burnished surfaces (though other vessels besides fine wares could also be burnished). The designation of a sherd as a "fine ware" was subjective; however, the difference in appearance and feel between fine wares and other wares was so dramatic that I am confident in the treatment of "fine wares" as a separate analytical category. I expect further study to demonstrate the difference statistically.

Because body sherds of fine wares were easily identifiable due to their thinness and fabric, they were recorded as well as rim sherds to study whether the density of fine wares on site changed over time. Fine ware rims were included in the counts of serving ware rims, but were also recorded separately.

Ceramics by Excavation Phase

Limiting the ceramics study to the rim sherds of most vessel categories and

including body sherds only of the fine ware category significantly decreased the number of sherds to be studied. This made it possible to study 100% of the identified rim sherds and fine ware body sherds. Although it is possible that some rim sherds and fine ware body sherds were missed during the study, these are expected to make up only a small fraction of the total rim sherds and fine ware body sherds, and are not expected to affect the outcome of the study.

Excavation Phase 1

Very few diagnostic sherds were found in the Phase 1 sediments: 1 rim of serving ware and 6 fine ware body sherds. The numbers of each category of sherd were divided by the total numbers of buckets of sediment excavated from Phase 1, 26 buckets, to get densities of sherd types per bucket (see Table 4).

Table 4: Level 1 sherd type densities

Diagnostic Sherd Type	**Serving Ware Rims**	**Cookware Rims**	**Storage Jar Rims**	**Fine Ware Rims**	**Fine Ware Body Sherds**
Density per bucket	0.04	0	0	0	0.23

Excavation Phase 2

Phase 2 sediments contained 152 serving ware rims, 69 cookware rims, 68 storage jar rims, 80 fine ware rims, and 205 fine ware body sherds. The numbers of each category of sherd were divided by the total numbers of buckets of sediment excavated from Phase 2, 270 buckets, to get densities of sherd types per bucket (see Table 5).

Table 5: Phase 2 sherd type densities

Diagnostic Sherd Type	**Serving Ware Rims**	**Cookware Rims**	**Storage Jar Rims**	**Fine Ware Rims**	**Fine Ware Body Sherds**
Density per bucket	0.56	0.26	0.25	0.3	0.76

Excavation Phase 3

Phase 3 sediments contained 18 serving ware rims, 1 cookware rim, 14 storage jar rims, 8 fine ware rims, and 5 fine ware body sherds. The numbers of each category of sherd were divided by the total numbers of buckets of sediment excavated from Phase 3, 106.5 buckets, to get densities of sherd types per bucket (see Table 6).

Table 6: Phase 3 sherd type densities

Diagnostic Sherd Type	**Serving Ware Rims**	**Cookware Rims**	**Storage Jar Rims**	**Fine Ware Rims**	**Fine Ware Body Sherds**
Density per bucket	0.17	0.01	0.13	0.08	0.05

Excavation Phase 4

Phase 4 sediments contained 163 serving ware rims, 57 cookware rims, 62 storage jar rims, 118 fine ware rims, and 279 fine ware body sherds. The numbers of each category of sherd were divided by the total numbers of buckets of sediment excavated from Phase 4, 311.05 buckets, to get densities of sherd types per bucket (see Table 7).

Table 7: Phase 4 sherd type densities

Diagnostic Sherd Type	**Serving Ware Rims**	**Cookware Rims**	**Storage Jar Rims**	**Fine Ware Rims**	**Fine Ware Body Sherds**
Density per bucket	0.52	0.18	0.2	0.38	0.9

Excavation Phase 5

Phase 5 sediments contained 242 serving ware rims, 111 cookware rims, 107

storage jar rims, 153 fine ware rims, and 115 fine ware body sherds. The numbers of each category of sherd were divided by the total numbers of buckets of sediment excavated from Phase 5, 336.75 buckets, to get densities of sherd types per bucket (see Table 8).

Table 8: Phase 5 sherd type densities

Diagnostic Sherd Type	**Serving Ware Rims**	**Cookware Rims**	**Storage Jar Rims**	**Fine Ware Rims**	**Fine Ware Body Sherds**
Density per bucket	0.72	0.33	0.32	0.45	0.34

Diachronic Change

A statistical comparison (one-way ANOVA) of the densities of the different categories of diagnostic sherds across the phases at Sa Conca Sa Cresia does not show any significant differences. However, this is likely to be due to the small sample sizes and will hopefully be corrected by the complete ceramic study. Some slight differences in the densities of the different sherd categories, though not significant, may suggest interesting patterns, particularly when comparing Phase 2 and Phase 4, the two habitation phases at the site and the most likely phases to be directly comparable. First, serving ware densities show little change between Phase 2 and Phase 4 (see Figure 2), suggesting that the amount of consumption taking place remained relatively consistent between the two phases. However, the density of fine ware rim sherds increased slightly between Phase 2 and Phase 4, and the density of fine ware body sherds increased more substantially between the two phases (see Figure 3). This suggests that greater attention was being paid to the vessels from which food was being served and consumed during the later phase of the site's habitation. Greater care in the manufacture of the type of ceramics that would have been visible during public feasting or consumption events may suggest that the leaders living in Sa Conca Sa Cresia were beginning to develop an elite identity involving consumption, perhaps of particular products.

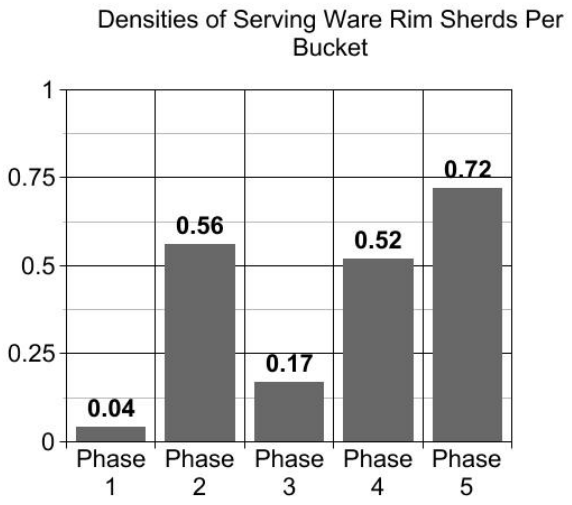


Figure 2: Densities of serving ware rim sherds per bucket

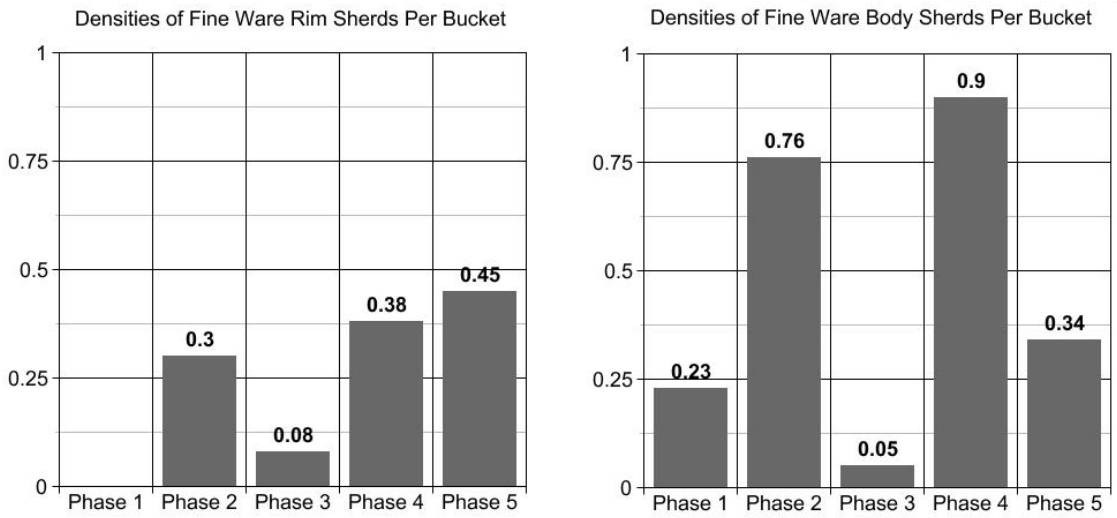


Figure 3: Densities of fine ware rim sherds and body sherds per bucket.

We would perhaps like to see an increase in the density of storage jar fragments accompanying the slight shift toward finer serving wares, indicating that an increased emphasis on acquiring and storing foods for feasts accompanied the increased emphasis on elegant consumption wares. However, this increase does not seem to have occurred (see Figure 4).

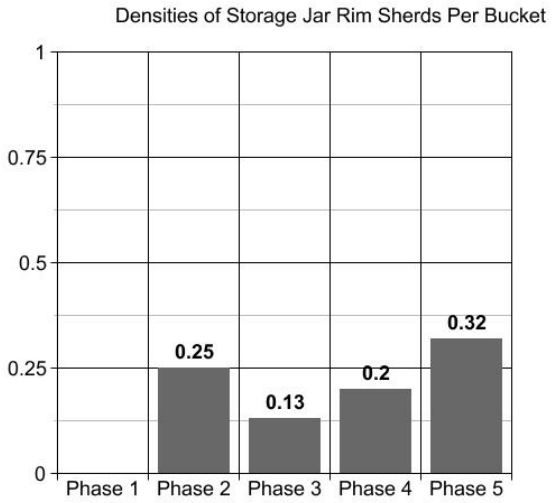


Figure 4: Densities of storage jar rim sherds per bucket

The density of storage jar fragments decreased slightly between Phase 2 and Phase 4, and though it increased somewhat in Phase 5, the fact that this is a destruction layer and may have been used as a midden area after the destruction occurred means that the density of finds in this layer should be interpreted with caution. It is possible that the amount of storage occurring at Sa Conca Sa Cresia did increase between Excavation Phase 2 and Excavation Phase 4, but that storage was moved out of the excavated habitation area to a different part of the site. This possibility may be supported by the slight decrease in cookware between Phase 2 and Phase 4, which could also be an indication that the function of the space changed slightly to focus more on consumption activities and less on other activities such as cooking or storage. However, it is impossible to evaluate this possibility without comparative data from other areas of the site, which would require a more extensive excavation.

Excavation Phase 1 and Excavation Phase 3 are noteworthy for their low densities of any kind of diagnostic ceramics. For Excavation Phase 1, the low densities are probably a product of the early stage of the settlement - few ceramics had been produced and used at the site by the end of this phase - and the short duration of the phase. For Excavation Phase 3, the low densities of diagnostic ceramics are probably related to the function of the excavated area during this phase. Trench I at Sa Conca Sa Cresia appears to have been used as a copper/bronze working area or possibly as a midden for

metalworking debris during Excavation Phase 3; it would not have been the location of much consumption, cooking, or storage.

Conclusions of Ceramics Study

The number of ceramics that could be studied for this preliminary report were small compared to the total assemblage, and although 100% of the most diagnostic sherds were studied, the results show no significant differences. Any changes in the densities of the different categories of diagnostic sherds densities can only point toward possible trends that may prove to be significant with further study. The most meaningful possible trend for the current study is that increases in the densities of fine ware rim and body sherds may suggest that the leaders living at Sa Conca Sa Cresia were developing elegant consumption or feasting practices as part of an elite identity.

FAUNAL REMAINS AT SA CONCA SA CRESIA

Despite the basaltic, acid soils found in the area of Siddi in south-central Sardinia, the excavations of Progetto Pran'e Siddi produced a large number of well-preserved animal bones and bone fragments. All excavated sediments were sieved through 1cm² mesh, allowing for excellent and consistent recovery. Approximately 5700 faunal remains were recovered from secure stratigraphic contexts in Trench I of the Sa Conca Sa Cresia excavations, 1273 of which had been studied by the writing of this preliminary report. Although this is only a 22% sample, the results of the complete study are not expected to deviate substantially from the results of the preliminary study. Because time limitations did not allow for a study of all the animal bones recovered during excavation, an effort was made to study a representative sample of remains from each occupational phase to ensure that diachronic change at the site could be discussed.

Overview of the Assemblage

The 1273 studied remains contained a high proportion of unidentifiable remains

(77% of the total sample, NISP 985), which further study may help reduce, but which is unlikely to decrease by a large percentage given the large amount of marrow fracturing (29% of total sample) and burning (34% of total sample) that the faunal remains were subjected to. A total of 288 remains (23% of the total sample) could be identified to some taxonomic level. Mammals made up 94% of the identifiable remains and 100% of the unidentifiable remains. The unidentified material was sorted by body region (skull, vertebra, rib and limb) and by size (small, medium, and large). A rabbit-sized animal was considered small, a sheep/goat- or pig-sized animal was considered medium, and a horse- or red deer-sized animal was considered large. A few bone fragments clearly came from small-to-medium or medium-to-large sized animals, but could not be assigned with confidence to a specific category; these were considered small/medium or medium/large.

Of the identifiable remains, sheep/goat predominated (12% of total sample, NISP 147), followed by pig (7%, NISP 86) and cattle (1%, NISP 15). Wild food species were also present in the assemblage, including birds (1%, NISP 16), the small rabbit-like rodent *Prolagus sardus* (1%, NISP 13), red deer (<1%, NISP 6), and marine mollusks (<1%, NISP 1). Finally, presumably non-food species were also present in small numbers, such as dog (<1%, NISP 1) and small rodents (<1%, NISP 3).

Sheep/goats

Sheep/goats made up the most common species in the assemblage by NISP. Of the 147 total identifiable remains, 34 could be identified as either sheep or goat. Nineteen of these remains were identified as sheep, while 15 were identified as goat, giving a ratio of 1.27 sheep for every goat for the assemblage as a whole. Limb bone fragments made up the majority of the sheep/goat remains (NISP 95), followed by skull fragments (NISP 49) and rib fragments (NISP 3). Of the 44 limb bone fragments that could be identified as either fore limb or hind limb fragments, 15 were fore limbs and 29 were hind limbs. This gives a ratio of 1:1.93 fore to hind limbs as opposed to the expected ratio of 1:1.1 (Redding 2010), showing a bias toward hind limbs.

Pigs

Pigs made up the second most common species in the assemblage by NISP, with a total of 86 identifiable remains. Skull bone fragments made up the majority of the identifiable pig remains (NISP 51), followed by limb bone fragments (NISP 34) and vertebrae (NISP 1). Of the 34 limb bone fragments, 6 were identified as fore limb fragments and 8 were identified as hind limb fragments, giving a ratio of 1:1.3 fore limb to hind limb fragments, which is close to the expected 1:1.1 ratio.

Birds

Birds were the next most common taxonomic category identified in the assemblage, with a total of 16 remains. Bird legs were the most commonly represented skeletal element (NISP 8), followed by limb fragments that could have come either from leg or wing bones (NISP 4), thoracic bones (NISP 3), and one fragment of skull. The bird bones in assemblage have not been studied in detail at this time, but they are all likely to come from wild species, since no domestic bird species are known for the Sardinian Middle Bronze Age.

Cattle

Fifteen remains of cattle were identified in the assemblage. Although the NISP of cattle is small, they could still have made up a significant portion of the meat consumed at the site because of their large size. Ten of the remains could be aged, only one of which was clearly killed while still a juvenile, between 6-15 months. This may suggest that cattle were used for traction, though none of the cattle remains showed stress pathologies.

Prolagus sardus, Red Deer, and Mollusks

Thirteen remains of *Prolagus sardus* were found in the sample of the assemblage studied, including seven skull fragments, five hind limb fragments, and one fore limb fragments. Only one of the limb fragments provided evidence of age, a fused proximal left tibia suggesting an adult animal. Six remains of red deer were also found in the sample of the assemblage studied, as well as a single marine bivalve shell.

Faunal Remains by Excavation Phase

Occupation at Sa Conca Sa Cresia has been divided into five phases based on stratigraphy, architectural changes, and radiocarbon dates. Phase 1 is considered to be pre-Nuragic or very early Nuragic and consists of the hard-packed clay foundation layer (US 42) on which the original corridor structure was built and a single clay occupation layer overlying it (US 39). Phase 2 begins with the enlargement of the corridor structure into the naviform room (but see discussion in Chapter) and is the first major occupation of the Trench I area of Sa Conca Sa Cresia. Phase 2 is followed by Phase 3, a period in which the naviform room was used as a metalworking area. During Phase 4, the area was resurfaced with a packed-clay floor, subdivided with a small internal wall, and reoccupied. Phase 5 was formed by the abandonment of the site and contains a large amount of burned daub, probably roof-collapse.

Excavation Phase 1

There are very few animal remains from Phase 1. The clay foundation layer of Phase 1 (US 42) contained no animal bones, and the single occupation layer associated with Phase 1 (US 39) contained only a few. A total of 13 animal bone fragments were found in the 26 buckets of sediment excavated from Phase 1, giving a density of 0.5 fragments per bucket. Six of the 13 remains were studied for this report (a 47% sample). Two of the fragments were from sheep/goat, one was from a *Prolagus sardus*, and three were unidentifiable mammal bone fragments, one from a large animal and two from medium-sized animals. Seventeen percent (NISP 1) of the studied remains showed evidence of burning, 33% (NISP 2) had been broken open to extract marrow, and 17% (NISP 1) showed evidence of having been gnawed by a carnivore, probably a domestic dog.

Excavation Phase 2

A total of 2178 animal bones were found in the 270 buckets of sediment

excavated from Phase 2, giving a density of 8.1 fragments per bucket. However, this density may be skewed by the extremely high density of bone fragments in SU 47, a foundational layer in which midden deposits had been used as leveling fill. Seven hundred seventy one animal remains were found in 42.75 buckets of excavated sediment in SU 47, giving an extremely high density of 18.0 remains per bucket. When US 47 is removed from the calculation, the overall density of animal remains in Phase 2 is 6.2 per bucket.

Seven hundred fifteen of the 2178 total recovered remains were studied, a 33% sample. Of the bones studied, 23% (NISP 161) could be identified to some taxonomic level and 77% (NISP 554) could be identified only as mammal bone fragments. Of the identifiable remains, sheep/goat were the most numerous at NISP 88. A total of 17 sheep/goat remains could confidently be identified as either sheep (NISP 12) or goat (NISP 5), giving a ratio of 2.4 sheep for every one goat. Pigs were the next most common species represented in the identifiable remains, with a total of 39 NISP. Eleven cattle remains were found in the assemblage.

Wild species also made an important contribution to the diet during Excavation Phase 2. A total of 8 *Prolagus sardus* remains, 6 bird remains, and 5 red deer remains were found. In addition, a few presumably non-food species were also represented, with 3 small rodent remains and one dog bone.

Of the 554 remains that could be identified only as mammal bone fragments, 82% (NISP 453) came from medium-sized animals, 11% (NISP 61) came from large animals, 3% (NISP 18) came from small/medium animals, 2% (NISP 13) came from medium/large animals, and 2% (NISP 9) came from small animals.

Of the total studied sample for Phase 2, 32% of the remains (NISP 231) showed evidence of burning, 3% (NISP 24) showed evidence of butchering marks, 29% (NISP 205) had been broken open to extract marrow, 17% (NISP 80) showed evidence of having been gnawed by dogs, and 2% (NISP 12) showed evidence of having been gnawed by rodents.

Excavation Phase 3

A total of 265 animal bones were found in the 106.5 buckets of sediment

excavated from Phase 3, giving a density of 2.5 fragments per bucket. One hundred eleven of the 265 recovered remains were studied, a 42% sample. Of the studied remains, 19% (NISP 21) could be identified to some taxonomic level and 81% (NISP 90) could be identified only as mammal bone fragments. Twelve remains could be identified as sheep/goat (8 sheep/goat, 2 sheep, 2 goat), making up the largest percentage of the identifiable remains, with a 1:1 ratio of sheep to goats. Bird remains were the next most common, with 5 identifiable remains, followed by pig (NISP 3) and cattle (NISP 1). One peculiarity of the faunal remains in Phase 3 is that the majority of them were dyed a bright turquoise color through contact with copper oxide present in the Phase 3 sediments (Image 41).

Image 41: Faunal remains from the metalworking deposits dyed blue-green by copper oxide. Photo E. Holt.

Of the 90 remains that could be identified only as mammal bone fragments, 83% (NISP 75) came from medium-sized animals, 6% (NISP 5) came from large animals, 4% (NISP 4) came from medium/large animals, and 2% (NISP 2) came from small animals. Four fragments were too undiagnostic to determine the size of the animal they had come from.

Of the total studied sample for Phase 3, 69% of the remains (NISP 77) showed

evidence of burning, 1% (NISP 1) showed evidence of butchering marks, 22% (NISP 24) had been broken open to extract marrow, and 8% (NISP 9) showed evidence of having been gnawed by dogs.

Excavation Phase 4

A total of 701 animal bones were found in the 311.05 buckets of sediment excavated from Phase 4, giving a density of 2.3 fragments per bucket. Two hundred sixty seven of the 701 recovered remains were studied, a 38% sample. Of the bones studied, 23% (NISP 61) could be identified to some taxonomic level and 77% (NISP 206) could be identified only as mammal bone fragments. Of the identifiable remains, pigs were the most numerous at NISP 30, followed by sheep/goat at NISP 23 (19 sheep/goat, 1 sheep, 3 goat), with a ratio of 0.3 sheep for every goat. Cattle were the least numerous domestic species at NISP 3. A few wild species were represented in the assemblage, including birds (NISP 2), *Prolagus sardus* (NISP 1), red deer (NISP 1), and marine mollusks (NISP 1).

Of the 206 remains that could be identified only as mammal bone fragments, 77% (NISP 159) came from medium-sized animals, 14% (NISP 28) came from large animals, 3% (NISP 7) came from small/medium animals, 3% (NISP 6) came from medium/large animals, and 3% (NISP 6) came from small animals.

Of the total studied sample for Phase 4, 42% of the remains (NISP 111) showed evidence of burning, <1% (NISP 1) showed evidence of butchering marks, 36% (NISP 96) had been broken open to extract marrow, 9% (NISP 25) showed evidence of having been gnawed by dogs, and 2% (NISP 4) showed evidence of having been gnawed by rodents.

Excavation Phase 5

A total of 2555 animal bones were found in the 336.75 buckets of sediment excavated from Phase 5, giving a density of 7.6 fragments per bucket. Of the 255 recovered remains, 173 were studied (a 7% sample). Due to time constraints and the size of the overall faunal assemblage, it was impossible to thoroughly study all phases. Excavation Phase 5 was chosen to receive the least attention because, as a destruction and

fill layer, its formation processes are quite different from those of the other phases and therefore its assemblage is less likely to be comparable to the other assemblages. Further study will correct the small sample currently available from this phase.

Of the 173 remains studied from Phase 5, 24% (NISP 42) were identifiable to some taxonomic level while 76% (NISP 131) were identifiable only as mammal remains. Sheep/goats made up the largest percentage of the identifiable remains (NISP 22: 13 sheep/goats, 4 sheep, 5 goats), with a ratio of 0.8 sheep for every goat. Pigs were the next most numerous (NISP 14), followed by birds (NISP 3) and *Prolagus sardus* (NISP 3). Cattle and red deer were not identified in the studied sample of Phase 5.

Of the 131 remains that could be identified only as mammal bone fragments, 76% (NISP 99) came from medium-sized animals, 11% (NISP 14) came from large animals, 8% (NISP 10) came from medium/large animals, 5% (NISP 6) came from small/medium animals, and 2% (NISP 2) came from small animals.

Of the total studied sample for Phase 5, 10% of the remains (NISP 17) showed evidence of burning, 1% (NISP 2) showed evidence of butchering marks, 25% (NISP 43) had been broken open to extract marrow, 10% (NISP 17) showed evidence of having been gnawed by dogs, and <1% (NISP 1) showed evidence of having been gnawed by rodents.

Diachronic Change in Animal Consumption

As discussed in the preceeding ceramics study, the two excavation phases of Sa Conca Sa Cresia Trench I that offer the best possibilities for diachronic comparison are Excavation Phases 2 and 4, both of which are occupation phases consisting of clay floors and hearths. Although the depth of the sediments and the number of floors and hearths present in Excavation Phase 2 indicate that it had a longer occupation history than Excavation Phase 4, the similarity of the deposits and features present suggests that the two phases represent comparable types of activities.

The goal of the diachronic study is to test for significant differences between the two assemblages that could indicate changes in status, economic strategies, prestige and display strategies, and the local environment. Not all specimens could be used for all

analyses, so exact NISP is given for each test. All analyses were performed on NISP, and results were considered significant at 95 percent confidence or higher.

Taxa

Comparing the relative representation of taxa in the faunal assemblages for the two habitation phases shows a significant difference in the composition of the two assemblages (p-value = 0.015, contingency table with Pearson's Chi-squared test, see Table 21), and gives one expected and one unexpected result. Percentages of all wild taxa, birds, deer, and the now-extinct rabbit-like rodent *Prolagus sardus*, decline slightly between the first and second habitation phases. This would be as expected if Nuragic elite subsistence focused progressively on raised rather than hunted animals, and may suggest a decrease in wild habitat as more land came under cultivation. However, the percentage of sheep and goats in the faunal assemblage declined substantially between the phases, while the percentage of pigs increased. This is the opposite of what might be expected for a local environment consisting mostly of maquis and grassland and may indicate that the pigs were being raised in more forested areas farther away and were then imported to the site.

Table 9: Diachronic comparison of genera

Taxon	**Phase 2**	**Phase 4**
Aves	3.8 % (NISP 6)	3.3% (NISP 2)
Prolagus sardus	5.1% (NISP 8)	1.6% (NISP 1)
Cervidae	3.2% (NISP 5)	1.6% (NISP 1)
Bos	7.0% (NISP 11)	4.9% (NISP 3)
Ovis/Capra	56.1% (NISP 88)	37.7% (NISP 23)
Sus	24.8% (NISP 39)	50.8% (NISP 31)
Total NISP	**157**	**61**

The contingency table above may not be entirely reliable, since it did have five expected frequencies that were less than five. The primary difference between the two

levels appears to be the change in the use of sheep/goats and pigs. If the frequency of sheep/goat and pig remains are compared separately, no expected frequencies are less than five and the change in the use of sheep/goats and pigs is clearly statistically significant (p-value = 0.001, contingency table with Fisher's Exact Test, see Table 10).

Table 10: Diachronic comparison of sheep/goat and pig

Taxon	**Level 2**	**Level 4**
Ovis/Capra	69.3% (NISP 88)	42.6% (NISP 23)
Sus	30.7% (NISP 39)	57.4% (NISP 31)
Total NISP	**127**	**54**

Animal Sizes (Unidentifiable Remains)

No significant difference was found between the relative representation of animal sizes between the two assemblages (p-value = 0.607, contingency table with Pearson's Chi-squared test, see Table 11).

Table 11: Diachronic comparison of size classes of unidentifiable remains

Animal Size	**Phase 2**	**Phase 4**
Large	11.0% (NISP 61)	13.6% (NISP 28)
Medium/Large	2.3% (NISP 13)	2.9% (NISP 6)
Medium	81.8% (NISP 453)	77.2% (NISP 159)
Small/Medium	3.2% (NISP 18)	3.4% (NISP 7)
Small	1.6% (NISP 9)	2.9% (NISP 6)
Total NISP	**554**	**206**

These results may not be entirely reliable because one of the expected frequencies in the contingency table is less than five. Redoing the contingency table focusing only on the changes between large and medium-bodied animals gives the same result: the changes in

animal size are not significant (p-value = 0.305, contingency table with Fisher's Exact Test, see Table 12).

Table 12: Diachronic comparison of large and medium size classes of unidentifiable remains.

Animal Size	**Level 2**	**Level 4**
Large	15% (NISP 28)	11.9% (NISP 61)
Medium	85% (NISP 159)	88.1% (NISP 453)
Total NISP	**187**	**514**

These results are not unexpected, given that the decreases in the large and small mammal taxa - cattle, red deer, and *Prolagus sardus* - between Phase 2 and Phase 4 are small. The primary difference between Phase 2 and Phase 4 is the decrease in sheep/goats and the increase in pigs, both medium-sized species, a change that would not affect the relative representation of medium-sized animals among the unidentifiable remains unless processing practices also changed.

Mammal Skeletal Elements

No significant difference was found in the relative representation of different mammal skeletal elements between the two assemblages (p-value = 0.27, contingency table with Pearson's Chi-squared test, see Table 13). This suggests that the ways in which animals were butchered and consumed did not change substantially over time. The balanced representation of skeletal elements suggests that, for the most part, whole animals were being consumed and discarded at the site. The one exception is the category of vertebrae, which are somewhat under-represented. This may be because vertebrae are small and can be fragile, especially if subjected to burning or boiling.

Table 13: Diachronic comparison of skeletal element categories

Element Category	**Phase 2**	**Phase 4**
Heads	26.6% (NISP 186)	24.1% (NISP 63)
Vertebrae	5.4% (NISP 38)	3.1% (NISP 8)
Ribs	16.6 (NISP 116)	15.7% (NISP 41)
Limbs	51.4% (NISP 359)	57.1% (NISP 149)
Total NISP	**699**	**261**

Marrow Processing

A significant difference in the amount of marrow processing taking place was found between the two assemblages (p-value = 0.028, contingency table with Pearson's Chi-squared test, see Table 14). Slightly more marrow processing took place in Phase 4 than in Phase 2.

Table 14: Diachronic comparison of marrow processing

Processed for Marrow	**Phase 2**	**Phase 4**
Yes	28.7% (NISP 205)	36% (NISP 96)
No	71.3% (NISP 510)	64% (NISP 171)
Total NISP	**715**	**267**

Discussion

Both identifiable and unidentifiable remains indicate an elite diet primarily focused on small livestock with some use of cattle and some use of hunted resources. No skewed representations of skeletal element groups were identified, indicating that domestic animals were probably raised at the site or were brought to the site alive or as whole carcasses.

There were few diachronic changes identified in the assemblage; however, the

changes that were identified may be meaningful. The first is an increase in the consumption of pigs at the expense of ovicaprids. This is somewhat counterintuitive given that ovicaprids are better suited to being raised in a Mediterranean maquis environment like the one that prevailed on the the Siddi Plateau in the Middle Bronze Age (Dighton and Fairbairn 2012; Marsh 2012; Veal 2012). The increased effort taken to raise pigs rather than ovicaprids, which would have required pig husbandry to take place off of the plateau in areas with more naturally-occurring shade and water, suggests that pigs had a special significance in the diet of Siddi's Nuragic elite. Pigs may have been a preferred feasting or prestige food which elites concentrated on raising despite the extra costs.

The second diachronic change is unexpected and somewhat difficult to interpret: marrow processing increases in the later phase of the site's occupation. This is counterintuitive given that architectural and artifactual data both indicate increased amounts of labor capture, craft production and specialization, and natural resource exploitation, all indications of growing social complexity and political power (see discussion in Chapter 9). Increased marrow processing is generally taken to indicate a lack of other sources of fat in the diet, a problem we would not expect to see an incipient elite encounter. Perhaps the increase in marrow processing was related to the increasing focus on pig husbandry. If pigs were an important prestige food, it may be that pig marrow also developed an importance as especially prestigious or delicious.

Conclusions of Faunal Remains Study

The overall picture of animal consumption at Sa Conca Sa Cresia is one of an expected mix of strategies for the Mediterranean Bronze Age with a lack of pronounced specialization in any particular domestic species. Hunting and gathering of animal protein resources played a small but consistently important role in the economy, representing animals that would have been available in the immediate vicinity, like *Prolagus sardus* and some bird species, as well as animals that Nuragic elites would have had to travel or exchange offsite to acquire, such as red deer and marine mollusks. A preference for pigs seems to have developed during the course of the site's occupation, suggesting that pigs

may have played a role as an elite feasting or prestige food.

DIACHRONIC CHANGE AT SA CONCA SA CRESIA

Nuragic Beginnings

Discussing the earliest evidence for the Nuragic culture on the Siddi Plateau is difficult due to the general lack of excavated evidence and the fact that this period of occupation is represented by only two shallow stratigraphic layers at Sa Conca Sa Cresia. Assessments of the earliest Nuragic occupation on the plateau will therefore necessarily be more truncated than discussions of the pre-metalworking and post-metalworking phases.

It is impossible to say in exactly what order the monuments of Siddi Plateau were built, and the fact that Sa Mammonaia was left unfinished suggests that all the monuments were not begun and completed at the same times. The available excavation evidence indicates that the two largest nuraghi, Sa Conca Sa Cresia and Sa Fogaia, as well as the giant's tomb were all built in the Middle Bronze Age. This suggests that at least these three monuments were among the earliest structures on the plateau. These structures relate to several of the elite strategies identified in the model proposed in Section I of this dissertation. First, they are clear evidence of monumental building, indicating that the organization of group labor was part of Nuragic elite strategies from early on. Second, the nuraghi themselves clearly indicate that residential segregation was part of the early Nuragic culture, though whether the giant's tomb on the Siddi Plateau - and giants' tombs in general - indicate elite mortuary segregation is still being debated. Sa Domu 'e s'Orcu, the giant's tomb on the Siddi Plateau, includes a large niche built into the west side of the interior corridor. Even if all the inhabitants of the Siddi Plateau community had access to burial in Sa Domu 'e s'Orcu, the presence of a niche suggests that some kind of segregation of burials may have taken place within the tomb.

Finally, the forecourt of giants' tombs in general, and of Sa Domu 'e s'Orcu specifically, have been identified as the loci of community ritual, probably involving feasting. Pottery vessels, particularly bowls, have been found buried in the forecourts of

giants' tombs, including Sa Domu 'e s'Orcu. While the nature of community ritual means it can undermine or support elite authority depending on the content of the ritual and the elite's role in organizing it, previous research has identified a link between giants' tombs and nuraghi that becomes stronger over the course of the Nuragic Period (Blake 1999) (see discussion in Chapter 6). It is impossible to say whether the group ritual practiced at Sa Domu 'e s'Orcu at the beginnings of the plateau's occupation helped reinforce elite authority or instead challenged it by affirming the contributions of the community, but the presence of the niche in the tomb's architecture hints that the new tomb may not have been completely egalitarian.

It is also important to consider that Sa Domu 'e s'Orcu was a new construction related specifically to the Middle Bronze Age building program on the plateau and built closest to the largest of the plateau's nuraghi. As discussed in Chapter 7, an Eneolithic/Early Bronze Age shaft-grave-turned-giant's tomb is located at the base of the plateau (see Image 24), but this structure went out of use at the end of the Early Bronze Age. It is likely that Sa Domu 'e s'Orcu is its replacement, built to more conveniently serve the community as it shifted focus from the lowlands to the plateau. The earlier Eneolithic/Early Bronze Age giant's tomb was built in the stele style with the carved door iconography typical of the pre-Nuragic period, but Sa Domu 'e s'Orcu was built in the coursed-stone nuragic style often associated with giants' tombs that are built contemporarily or subsequently to the building of nuraghi. The pronounced break with the giants' tomb ritual of the more egalitarian past through the rejection of both the earlier site and the earlier iconography may suggest that the ritual taking place in Sa Domu 'e s'Orcu's forecourt served the interests of the elite to a greater extent than pre-Nuragic ritual in the Siddi Plateau area.

The excavated materials from Sa Conca Sa Cresia that relate to the early Nuragic beginnings of the site are few. Only two stratigraphic layers yielding twenty-six buckets of excavated sediment date to the site's foundation, and only a handful of artifacts and ecofacts were found in these layers. A spindle whorl and a burnishing stone suggest that cloth and pottery production took place at the site. Obsidian and three other examples of non-local stone indicate that raw materials were sourced from other areas of the island (Image 42). Only six diagnostic ceramic sherds were found in the earliest phase, but all

were from serving vessels and the majority of them were classified as fine ware. Very few animal remains were recovered; the few there were indicate sheep/goat husbandry, hunting of *Prolagus sardus*, and the use of some large-bodied mammal, probably cattle or red deer. The palaeobotanical remains include a few grains each of wheat and barley and one olive stone as well as an unusually large number of chaff fragments compared to other samples taken from the site. It is not possible to determine whether the olive stone is from a wild or domesticated olive.

Image 42: Map showing source of non-local natural resources found at Sa Conca Sa Cresia in the earliest occupation phase. The red dot indicates the Siddi Plateau. The blue dot indicates Monte Arci (obsidian).

The Pre-Metalworking Phase

It is important to begin by stating that the evaluation of this phase as a "pre-metalworking" phase is based on the absence of evidence. There is no evidence of any kind for metalworking during this phase: no ore and no slag. It is interesting to note that

five sharpening stones were recovered from this phase, indicating that metal tools were present and being used even if they were not deposited. However, the metal tools that were being used at Sa Conca Sa Cresia in this phase were not necessarily being made there, and metal implements of all kinds were still rare during and at the end of the Early Bronze Age. Without direct evidence for metal working in the early phases at Sa Conca Sa Cresia, it seems best to assume that metal working was not yet taking place there.

The lack of metal working during the pre-metalworking phase does not indicate a low level of craft production or of the acquisition of non-local resources. Two spindle whorl fragments and two burnishing stones indicate that pottery and cloth production continued to take place at the site.

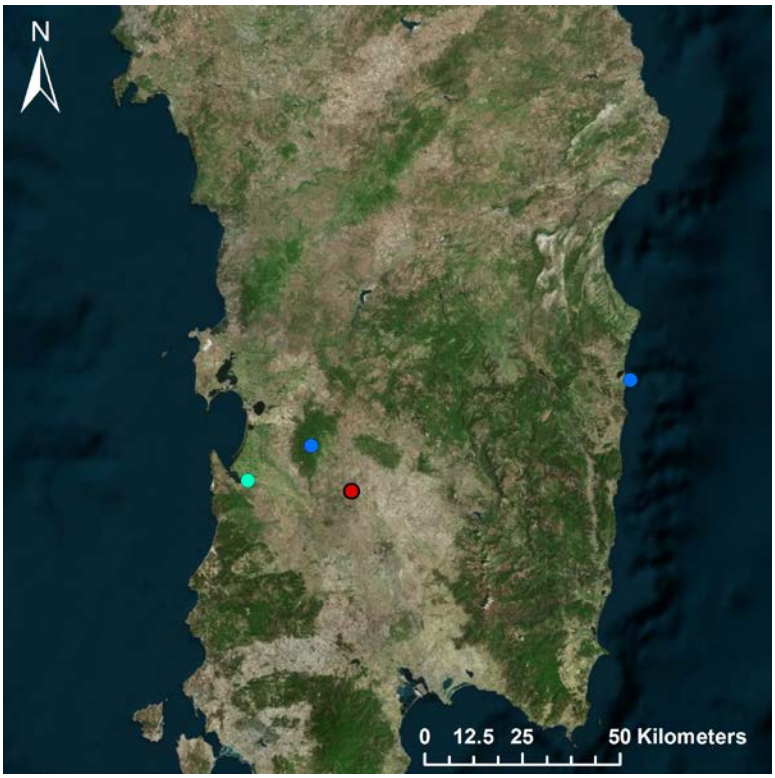


Image 43: Map showing sources of non-local raw materials found at Sa Conca Sa Cresia during the pre-metalworking phase. Blue dots represent Monte Arci (obsidian) and Arbatax (porphyry). The light blue dot indicates the Lagoon of Oristano (shellfish).

In addition to obsidian, which continued to be quite common, other non-local materials are found at the site (Image 43). Four marine bivalve shells indicate that the

inhabitants of Sa Conca Sa Cresia had contact with the coast, probably around the Lagoon of Oristano, the closest ocean coastline to the Siddi Plateau. A fragmentary mace head made of porphyry (Image 44) probably came from the porphyry outcroppings near the modern village of Arbatax. Arbatax is over 70 km west northwest of the Siddi Plateau and lies on the opposite side of the Gennargentu mountain range, which contains the tallest peaks in Sardinia. Whether the porphyry mace head traveled as a chunk of raw material, a valuable exchange good, or a prized possession carried to Siddi by an immigrant, it represents a long and difficult journey.

Image 44: Porphyry mace head from Sa Conca Sa Cresia pre-metalworking phase. Photo E. Holt.

The porphyry mace head is not the only artifact referencing violence found in the pre-metalworking phase at Sa Conca Sa Cresia. An obsidian projectile point (Image 45)

also hints at violence, though unlike the mace head, the projectile point could also have been used for hunting. The presence of a projectile point in a stratified Nuragic context is unusual in and of itself. Projectile points on Sardinia have been thought to be exclusively Neolithic in manufacture, and it is certainly possible that the one found in the pre-metalworking phase is actually a Neolithic artifact picked up and preserved by the inhabitants of Sa Conca Sa Cresia. The style of the point is consistent with other Neolithic projectile points in the area, and they are a common surface find: two were discovered as surface finds during the course of excavations and nine more were recovered from topsoil layers. However, additional projectile points were found in stratified contexts in the post-metalworking phase, suggesting that if the points were not actually being manufactured during the Nuragic period, they at least remained consistently important, whether as re-usable weapons or as valuables of some kind.

Image 45: Obsidian projectile point found in Sa Conca Sa Cresia pre-metalworking phase. Photo E. Holt.

Food processing was also an important activity at the site during the pre-metalworking phase. Seventeen grinding stones and three quern fragments indicate food preparation, though the small amount of chaff remains (Dighton and Fairbairn 2012) may indicate that most primary processing took place elsewhere. The diet focused on cereals,

predominantly free-threshing wheat with some two-rowed barley and some six-rowed barley, with very small contributions made by legumes and fruits such as olive and grape (Dighton and Fairbairn 2012). Faunal remains indicate that sheep/goats were the most commonly raised animal (88 NISP, 55% of identifiable remains), followed by pigs (39 NISP, 24%) and cattle (11 NISP, 7%). The presence of *Prolagus sardus* (NISP 8), birds (NISP 6), and red deer (NISP 5) indicates that hunting also made an important contribution to the animal diet.

Post-Metalworking Phase

The transition to the post-metalworking phase is stratigraphically obvious, signaled by a relatively deep deposit of superheated ore that totaled 1065 liters. The ore remains have not yet been analyzed for source, but their high copper content is demonstrated by the fact that most of the animal remains found in this deposit had been dyed a bright blue-green from exposure to copper oxide (see Image 41). Two pieces of slag were also found in this deposit, the only slag recovered in stratigraphic context at the site.

The development of copper smelting at Sa Conca Sa Cresia has important implications. First, it suggests that metal began to increase in importance during the Middle Bronze Age formation of the Nuragic culture, at least in the Siddi Area. Evidence of smelting and metalworking has been found at other Nuragic sites, but mostly dating to the Late Bronze Age. The discovery of clear metalworking deposits at Sa Conca Sa Cresia indicates that metal may have become a desired good and a source of elite prestige and identity earlier than previously identified, though the rarity with which metal artifacts seem to have been deposited in the Middle Bronze Age suggests that metal as a raw material was still too rare and meaningful to take out of circulation by including much of it in burials or votive deposits.

Second, the way that metalworking developed at Sa Conca Sa Cresia suggests that metal resources had not yet been taken over and controlled by particular groups. The inhabitants of Sa Conca Sa Cresia were not acquiring metal as a raw material, they were acquiring ore, which they carried back to the Siddi Plateau for processing. In addition to

being a labor intensive process involving journeys of over 30 km to the nearest ore sources (see Image 46), the process of mining ore and then carrying away large amounts of it would have been dangerous and difficult if the resource was being monitored and guarded by local groups. Instead, it appears that metal ore, like obsidian during the Middle Bronze Age (Tykot 1992), was an open resource that could be gathered by anyone who made the trip.

Finally, although the smelting of copper ore became an important part of the economic activity at Sa Conca Sa Cresia, it appears to have been in a somewhat experimental stage. The wood charcoal evidence from the ore deposit shows the same signature of twiggy, maquis species as the rest of the site (Veal 2012), indicating that specialized charcoal production for more efficient smelting had not yet become part of the process.

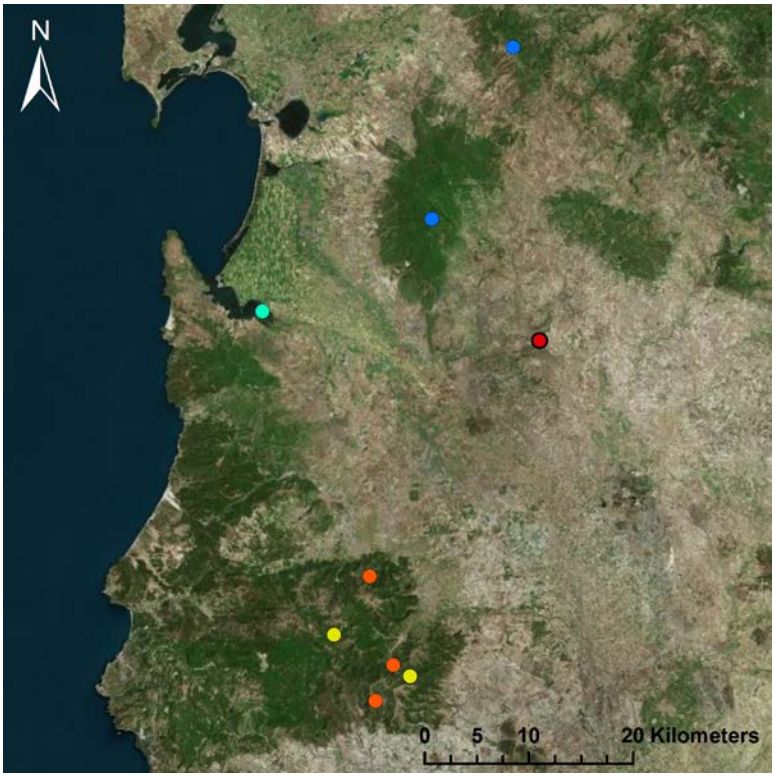


Image 46: Map showing sources of non-local raw materials found at Sa Conca Sa Cresia during the post-metalworking phase. Blue dots represent Monte Arci (obsidian) and Monte Grighine (chalcedony). Light blue dot represents the Lagoon of Oristano (shellfish). Orange and yellow dots represent copper and tin ore sources, respectively.

Evidence for another distant raw material, chalcedony, appears in this phase (Image 47). Chalcedony comes from deposits in Monte Grighine, about 25 km north of the Siddi Plateau. Its hardness, the fact that it can be flaked, and its often beautiful colors may have made it a prestige or display good for the elites of Sa Conca Sa Cresia, an alternative to the well-known obsidian of Monte Arci. In addition to this new raw material, other distant resources continued to be sourced: obsidian is common in the post-metal working phase, and there are a total of seven marine bivalve shells from these deposits.

Image 47: A green chalcedony core from Sa Conca Sa Cresia's post-metalworking phase. Photo E. Holt.

Craft production remained important at the site. Four burnishing stones, fifteen spindle whorls, and a probable loom weight (Image 49) indicate that pottery and cloth production continued. Five bone tools were found in the deposits. Two quern fragments and fourteen grinding stones indicate that food processing continued, though the palaeobotanical evidence shows a decrease in the amount of chaff in the deposits in this phase suggesting that some types of food processing no longer took place in this area of the site.

There is some evidence for artifacts referencing violence from this phase. Two mace head fragments made of local basalts and five projectile points (Image 48) suggest that the display of symbolic violence may have been important, even if the weapons were

Image 48: Three of the five obsidian projectile points found in Sa Conca Sa Cresia post-metalworking phase. Photo E. Holt.

never used for actual violence. Two episodes of burning also take place during the post-metal working phase. A destruction deposit caused by the burning of the space and the collapse of its roof caps the thick ore deposit, and the final stratigraphic layer at the site is again a burned destruction deposit including a collapsed roof. While both of these deposits may have been caused by accidents or by intentional, ritual closures of the space, a third possibility is that they may have been caused by violent raids.

Diet at the site during the post-metal working phase appears fairly similar to the diet of the pre-metal working phase. Wheat and barley continued to be the dominant crops, with an increase in the relative abundance of wheat and a decrease in six-rowed barely relative to two-rowed barley. Pigs replaced sheep/goats as the most common domestic animal (49% of the identifiable remains, NISP 30), with sheep/goats still playing an important role (38%, NISP 23), and cattle being the least common domestic animal numerically (5%, NISP 3). Wild animals such as birds (NISP 2), *Prolagus sardus*

(NISP 1), and red deer (NISP 1) also continued to be important resources at the site.

Image 49: Probable loom weight from Sa Conca Sa Cresia post-metalworking phase.

KEY COMPONENTS OF THE MODEL: THE EVIDENCE FROM THE SIDDI PLATEAU

Producer Mobility

The main factors influencing producer mobility are geography, land improvements, a culture of violence, and relative population density; at least some evidence for each of these factors was recovered for the Siddi Plateau. A detailed palaeogeographical reconstruction of the site was beyond the scope of the current project; however, the basic landforms of the area could be assessed in light of the evidence available for reconstructing the ancient environment. The plateau itself is quite flat and, although it is rocky in places, there are no large topographical disruptions anywhere on the plateau that would limit settlement options, mobility, or visibility. Additionally, the

combined environmental evidence strongly suggests that the areas exploited by the inhabitants of Sa Conca Sa Cresia were minimally forested, and were instead covered by scrubby maquis species very similar to the flora found on the plateau today. Wood charcoal evidence indicates the use of small (<10 to 30mm diameter) and medium-sized (30-50mm diameter) branches of scrub species such as *Pistacia lentiscus*, *Pistacia terebinthus*, *Olea* sp. (probably *Olea europea* ssp. *sylvestris*), *Erica arborea*, *Erica multiflora*, *Prunus avium* and *Prunus spinosa* for firewood; burning evidence suggests that the wood was minimally seasoned before burning, and was probably gathered expediently on a daily basis from areas near the site (Veal 2012). Deciduous trees were not represented at the site, and the evidence of the wood charcoal is supported by the phytolith and macrobotanial evidence, which both suggest the burning of animal dung for fuel (Dighton and Fairbairn 2012; Marsh 2012). The strong evidence for a relatively open, maquis-covered landscape with few large trees suggests that forestation would not have created difficulties for producer mobility on the plateau.

Geographical constraints to mobility would also have been minimal in the lowlands surrounding the plateau. The lowlands consist of plains and rolling hills, with basalt rocks and boulders that have weathered off and fallen from the plateau forming the only disruptions in the landscape. The greatest potential limiting factor for settlement in the lowlands would have been the availability of water; however, numerous springs dot the landscape and, as is shown by a Late Bronze Age elite site in the lowlands to the southeast, the water-table is high enough to allow for the digging of wells. The locations of good agricultural soils may also have affected producer mobility. The soils immediately surrounding the plateau have moderate agricultural productivity, but the soils located further to the east and south of the plateau have much higher levels of productivity (see discussion in Chapter 5). The influence of soil location may actually have been to encourage producer mobility rather than restrict it. Finally, ground cover may have been a limiting factor for mobility, and it is possible that the lowlands may have been moister than the plateau and supported thicker growth in the Middle Bronze Age than they do now. No evidence is currently available for the Bronze Age ground cover in the lowlands. It is possible that ground cover restricted mobility somewhat; however, it would have been one of the only limiting factors and we should therefore

consider geographical constraints on mobility to fall within a spectrum of minor to moderate in the lowlands.

There is very little evidence for the use of land improvements in the areas around the Siddi Plateau. Although some terraces were encountered during survey, these all appeared to be responding to the creation of steep cuts in the landscape during modern road construction and did not appear to be ancient. Although it is possible that ancient terraces did exist and have since been destroyed by modern farming methods, very little terracing is currently employed in the farming of the areas around the Siddi Plateau.

Evidence for irrigation systems was also not identified during survey, although other methods of locating irrigation systems such as the use of satellite imagery may prove more fruitful in the future. The current evidence indicates that any irrigation that took place was small-scale irrigation accomplished by transporting water in containers from a water source to the fields or by digging small canals. There is some evidence that irrigation of this kind took place: some very large multicells were identified among the phytoliths from the site, a situation that often occurs when plants are irrigated in dry environments with high rates of evapotranspiration (Marsh 2012). However, given that any irrigation that occurred must have been small-scale rather than having involved large investments of labor in constructing irrigation networks, irrigation was unlikely to have been a land improvement that limited producer mobility.

Evidence for a potential culture of violence is limited and relies almost entirely on indirect and symbolic evidence. No human remains were recovered during the excavations, and previous excavations of the giants' tomb on the plateau also did not recover any human remains, so it is impossible to directly assess the level of violence that the Nuragic occupants of the Siddi Plateau experienced. Indirect evidence for violence is suggested by the siting of the towers on top of the Siddi Plateau as opposed to in the lowlands, which were preferred for elite settlements in the Late Bronze Age and which have far greater agricultural productivity. The difficulty of reaching the towers on the plateau due to the plateau's very steep and sometimes sheer sides combined with the great advantage of high visibility achieved by siting the corridor nuraghi on the edges of the plateau suggests a concern with security, though the symbolic statement of power created by siting the corridor nuraghi on top of the plateau may also be a reason for their location.

The architecture of the corridor nuraghi themselves suggests a concern with security. The height of the towers and the presence of workspaces and residences on top of the some of the corridor nuraghi, particularly Sa Fogaia, show further efforts to create greater visibility. Also, the entrances of the nuraghi are invariably located facing toward the steep sides of the plateau. This would have limited the ability of invaders to enter the nuraghi and would have made defending the nuraghi easier, since forcing the invaders off the edge of the plateau would have resulted in injury and, in some places, death.

Possible evidence of violence may be suggested by Phase 5 of Trench I at Sa Conca Sa Cresia. This is the final phase of this area of the site, and it shows clear evidence of having been destroyed by burning. The largest density of burned daub was found in this phase, some of it with clear indications of the branches and reeds it had been pressed around. Phase 5 also contained the only evidence of large timbers (>200mm diameter for the *Pistacia* and >300mm diameter for evergreen oak), suggesting the presence of roof timbers or furniture, and the charcoal in this phase was heavily burned, suggesting a strong fire (Veal 2012). The fire could have been the result of a violent incursion, although the fire could also have been accidental or could have been a ritual way of formally closing the space.

Finally, there is some evidence of possible weapons among the materials excavated from Sa Conca Sa Cresia. Five whole and fragmentary *teste di mazza*, or "mace heads" were found during the excavations. Although these objects may have served utilitarian purposes as hammers, much more solid, round hammer stones were also recovered during the excavations. Given the fragile nature of the basalt and porphyry of which these mace heads were carved and the fact that they did frequently break, it seems more likely that they were intended for hitting soft objects, or were possibly intended to be more for show than for use. Although a purely utilitarian function of the mace heads is possible, it seems more likely that they were made to reference the possibility of violent conflict, and may occasionally have been used for actual violence.

Relative population density is the most difficult mobility-limiting factor to discuss with the current state of the evidence. No non-elite settlements were known before the project began and survey did not securely locate any non-elite settlements, so no producer residences could be excavated. It was therefore impossible to reconstruct the production

and consumption patterns of producers directly from the evidence provided by their deposits, and general patterns must therefore be cautiously reconstructed based on the evidence from elite deposits.

Elite deposits show agricultural practices primarily based on barley and wheat, with some use of legumes such as *Vicia fava.* The relative importance of each of these crops in the producer diet cannot be inferred from their proportions in the elite diet; all that can be said is that these crops can be grown productively in a Mediterranean environment without necessarily investing in mobility-reducing land improvements such as terracing and irrigation, or in high-cost traction animals. Without additional evidence for investments in land-improvements or traction animals, it seems best to start with the base assumption that producers were not raising these crops intensively, and that investments in non-moveable resources would not have limited producer mobility.

For this study, only a 25% sample of the excavated faunal remains could be studied (NISP 1273 out of c. 5000). The studied remains contained a high proportion of unidentifiable remains (77% of the total sample), which further study may help reduce, but which is unlikely to decrease by a large percentage given the large amount of marrow fracturing (29% of total sample) and burning (34% of total sample) that the faunal remains were subjected to. Identifiable remains suggest an elite diet primarily focused on sheep/goat (12% of total sample) and pig (7%) with some use of cattle (1%), as well as an important contribution made by wild animals including birds (1%), red deer (<1%), and the small rabbit-like rodent *Prolagus sardus* (1%). Ten remains of cattle could be aged, only one of which was clearly killed while still a juvenile, between 6-15 months. This may suggest that cattle were used for traction, though none of the cattle remains showed stress pathologies. Though, again, it is impossible to reconstruct producer production/consumption patterns from remains found in elite deposits, the faunal remains from Sa Conca Sa Cresia suggest the expected mix of domesticates and do not strongly indicate intensive raising of a particular species or a focus on intensive agriculture using animal traction. The presence of a small but meaningful percentage of wild species, particularly deer, suggests that there were uncultivated woodlands nearby that would make good deer habitats. Taken together, the lack of intensive agriculture and animal husbandry combined with the presence of wild habitat does not suggest that land in the

Siddi area was heavily exploited.

In order to assess relative population density, evidence for subsistence strategies must be compared with evidence for absolute population. A low-to-moderate Bronze Age artifact density was identified in all off-site areas that were surveyed, with the exception of Field CSC 4, immediately to the east of Sa Conca Sa Cresia, where the deposition of additional artifacts eroded from the site above is probably skewing the artifact density. Use of the lowlands appears to have been sparsest to the northeast of the plateau, in the area nearest to the settlement system of the Gesturi Plateau, and somewhat denser to the southeast of the plateau, in an area farther from Geturi's potential threat but also closer to better agricultural soils. In the end, we can conclude only that the Nuragic population living on and around the Siddi Plateau made some use of the lowlands, and that the density of artifacts does not suggest a high relative population density. Although the information for non-elite production patterns is mostly conjectural at this stage of the research, probable agricultural and animal husbandry practices combined with the evidence for only a moderate level of frequentation of the areas around the Siddi Plateau during the Bronze Age do not suggest a high relative population density. Producer mobility was not likely to be very limited by a lack of sufficient additional territory to support population growth and new settlements.

Taken together, the evidence for constraints on producer mobility for the area around the Siddi Plateau during the Middle Bronze Age suggests that mobility would have been fairly available to producers as a form of resistance to oppressively demanding elites. The greatest potential limiting factor would have been a culture of violence, which may have influenced the site selection and building activities at least of the elite. The extent to which a prevailing culture of violence would have restricted producer movement is impossible to determine with the available evidence, and it is possible that producers had reasonably safe or recognized ways of shifting residence and allegiance from one elite-controlled area to another. A final factor to consider is the general lack of evidence for other Middle Bronze Age elite constructions within about an 8 km radius of the Siddi Plateau. Even if other groups were inclined to be hostile, the density of elite occupation on the landscape does not suggest that moving groups of producers would immediately be detected and attacked. We should therefore consider mobility to be a

highly available to moderately available strategy (see Table 13 for a summary of the evidence), initially placing the community of the Siddi Plateau in the left half of the x-axis on the diagram of the model (see Figure 5).

Table 15: Archaeological evidence for producer mobility on and around the Siddi Plateau

Constraint	**Excavated Evidence**	**Survey Evidence**	**Probable Level of Influence**
Geography	Wood charcoal, phytoliths, and macrobotanical remains all indicate maquis ground cover for plateau; excavated evidence not available for lowlands, indeterminate ground cover	Flat, open surface of the plateau; relatively flat lowlands with no major topographical disruptions that could limit settlement	Low on the plateau; low to moderate in the lowlands
Land Improvements	Presence of large multicells among phytoliths suggests use of irrigation	No evidence for terracing/irrigation was recovered during survey	Low
Culture of Violence	Phase 5 at Sa Conca Sa Cresia shows burning and roof collapse of occupied area; 5 mace heads and fragments were found in the excavations of Sa Conca Sa Cresia; no human remains recovered	No villages are currently known; elite sites located in defensible locations; elite sites show defensive architecture	Low to moderate
Relative Population Density	Food remains at elite site indicate a mix of cereal agriculture and animal husbandry focusing on sheep/goat and pig; production/consumption evidence for non-elite sites not available	Number of settlements not known; moderate off-site artifact density	Low

Subsistence Base

Like relative population density, the subsistence base for the Nuragic people of the Siddi Plateau is currently a difficult component of the model to reconstruct. As discussed above, this difficulty lies in the lack of evidence available for the production and consumption patterns of producers, both in villages and in any kind of special purpose sites that may have existed in the area.

Currently, no Nuragic special purpose sites are known in the Siddi area. Most Nuragic special purpose sites that have been identified are cave occupations that archaeologists suspect were used as human and animal shelters for pastoralists (Trump

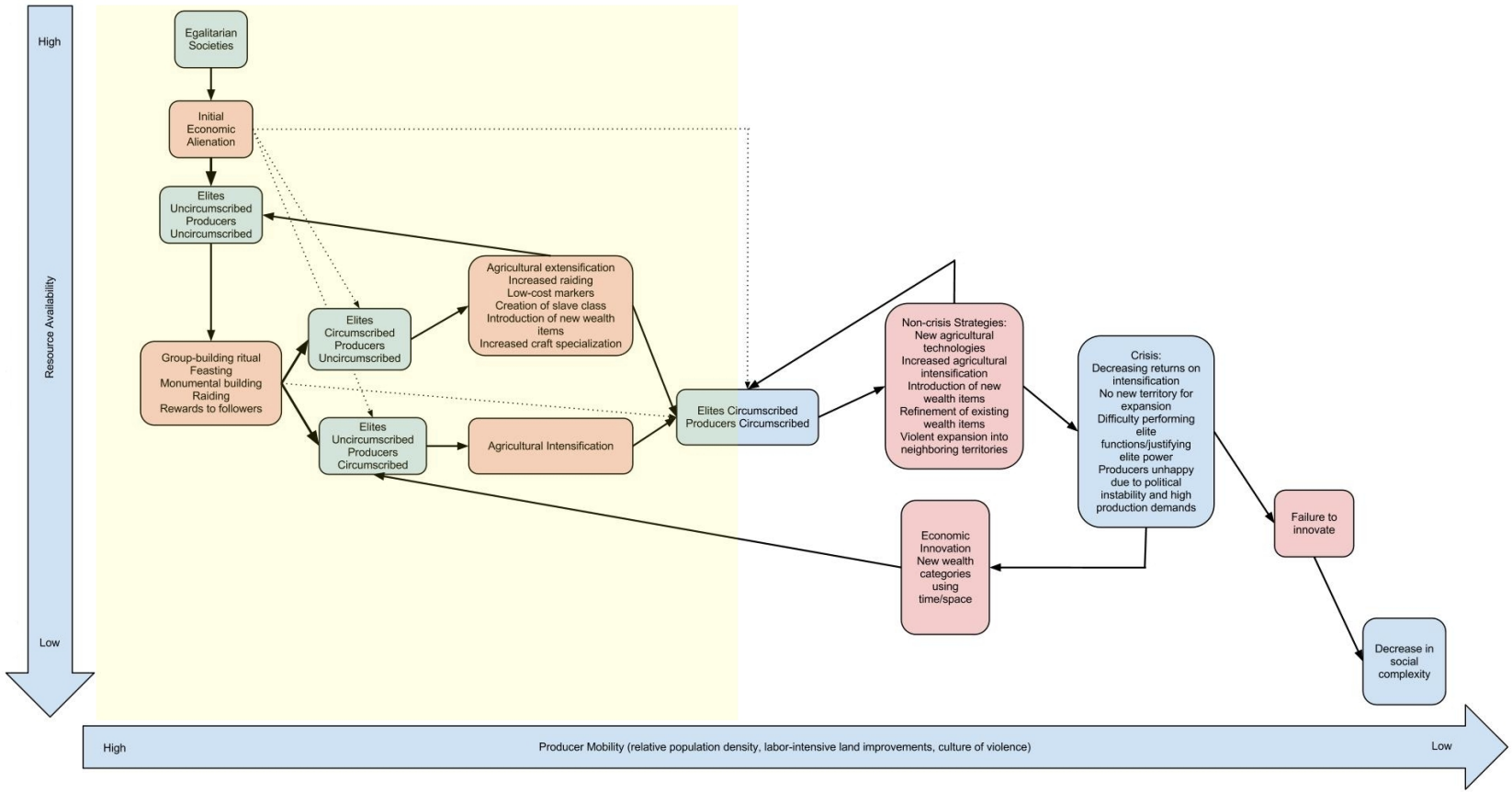


Figure 5: Economic model of social complexity with the left half of the x-axis shaded.

1984; 1986). However, the geology of the Siddi region does not promote cave formation, and no caves - with or without evidence of human use - are currently known in the area. This does not preclude the possibility that special purpose sites were constructed for use in pastoral activities; however, the role of specialized pastoralism in the Nuragic economy has been much questioned, and it is impossible to say whether we should expect special purpose pastoral sites in the archaeological record of Siddi or not.

Like special purpose sites, non-elite villages are not currently known in the Siddi area. However, unlike special purpose sites, whose existence cannot be assumed, it is impossible that no producers lived in the area around Siddi. Since it is also impossible that the population housed in each nuraghe was sufficient to build it (*contra* Webster 1991), there must have been producer residences and villages in the Siddi area, probably made of mostly perishable materials and leaving little in the way of a clear archaeological signature. Hopefully, future research will locate and excavate non-elite residences and villages in the Siddi area. For the purposes of this study, it will have to suffice to make educated guesses about the general subsistence base based on the evidence for elite production and consumption patterns provided by the evidence from Sa Conca Sa Cresia.

Fortunately, the patterns of elite consumption at Sa Conca Sa Cresia are similar to what might be expected for a West Mediterranean Bronze Age settlement, and do not look particularly specialized: "[t]he archaeobotanical assemblage of Sa Conca Sa Cresia is suggestive of people at the site exploiting a range of taxa that represent a reasonably standard set of practices for this period" (Dighton and Fairbairn 2012:14). This suggests that the elite agricultural activities represented by the assemblage at Sa Conca Sa Cresia may not be far removed from the consumption patterns of producers, and may be fairly representative of the general subsistence base in the Siddi area.

Although the palaeobotanical assemblage shows some important changes in subsistence over time, the general pattern is of cereal agriculture, including six-rowed barley, two-rowed barley, and wheat, with some use of legumes such as *Vicia fava* and some use of grapes and olives. It is impossible to determine from the small sample sizes whether the grapes and olives were wild or domesticated varieties (Dighton and Fairbairn 2012); however, the relative scarcity of these species in the assemblage suggests that they may not have been heavily exploited, though their scarcity may also be due to

particularities of processing that made cereal grains, weed seeds, and legumes more likely to be charred than grape pips or olive pits. Overall, the palaeobotanical remains suggest a plant diet that was dominated by cereals.

The analysis of the faunal remains indicates a fairly balanced mix of sheep/goat and pig husbandry, with contributions from cattle, birds, *Prolagus sardus*, and deer. None of the domestic animals were being raised intensively. In sum, the evidence for subsistence base at Sa Conca Sa Cresia appears to be fairly generalized and likely to reflect both elite and producer consumption patterns (see Table 14).

Table 16: Archaeological evidence for subsistence base on and around the Siddi Plateau

Information	**Excavated Evidence**	**Survey Evidence**
Territorial use	Pollen, phytoliths, and starch grains from soil cores	No evidence for large-scale irrigation and/or terracing found during survey
Producer subsistence	None currently available	N/A
Elite subsistence	Faunal remains; macrobotanical remains; pollen, phytoliths and starches from excavated soils	N/A
Subsistence at special-purpose site	No special-purpose sites currently known in the area; none currently available	N/A

Resource Availability

The evidence for resource availability in the Siddi area suggests a landscape in which animal resources were plentiful, soil resources were available but potentially subject to depletion, and timber resources were scarce. The presence of wild animals such as birds, *Prolagus sardus*, and red deer in the faunal assemblage indicates that these animals were available for hunting. Birds and *Prolagus sardus* were probably more readily available than red deer given the evidence that there was very little forest in the immediate vicinity of Siddi. Additionally, marine mollusks were not unknown at the site, indicating that the inhabitants of Sa Conca Sa Cresia either traveled to the sea periodically or had exchange connections on the sea. However, the very small numbers of these items present at the site do not suggest that over-harvesting of marine mollusks was a factor that could have affected resource availability.

Palaeobotanical and phytolith evidence suggests that soil in the area was utilized, but not heavily depleted. Seeds of *Heliotropium* and the Fabaceae/Brassicaceae families indicate disturbed and cultivated ground, but evidence of nitrogen depletion has not yet been identified, though studies of the botanical remains are ongoing (Dighton and Fairbairn 2012). The presence of sedge seeds (Dighton and Fairbairn 2012) and phytoliths (Marsh 2012) in the deposits, as well as the presence of large multicells among the phytoliths (Marsh 2012) may indicate the use of irrigation. However, the palaeobotanical evidence of wetland plants could also have been caused by a humid environment event and does not necessarily indicate irrigation (A. Dighton, pers. comm.). The cultivation of both barley and wheat and the increase of wheat cultivation over time suggest that if irrigation was being used it was not causing sufficient salinization of the soil to be a problem, or at least it was not a problem that affected the consumption patterns of the elite.

The evidence for timber resources indicates that wood was probably quite scarce. Analysis of the wood charcoals from the site show almost exclusively maquis species (Veal 2012), and the sizes of the branches burned indicate that the shrubs in the area of Siddi were small. Even the wood charcoal from the metalworking deposits, which we might expect to be specially sourced or prepared, shows the same expedient use of small maquis species. The only evidence for timber of any size comes from the destruction layer at the end of the site's occupation, and these timbers were probably specially sourced for furniture or roof beams (Veal 2012). Analysis of the palaeobotanical remains and phytoliths supports the conclusion that timber was scarce and valuable. Phytolith analysis shows a lower-than-expected ratio of grass phytoliths to tree phytoliths in hearths overall, suggesting the burning of animal dung as the primary source of fuel with some use of twigs as kindling (Marsh 2012). Palaeobotanical analysis found a lower-than-expected ratio of wood charcoal to carbonized seeds in the US 10 hearth in Phase 2 (Dighton and Fairbairn 2012), also suggesting that wood may not have been the primary fuel for most fires. The fact that wood was often not the primary fuel combined with the evidence for small branches and twigs being the only wood used in fires strongly suggests that large, high quality timbers were difficult enough to obtain that they were reserved for use in building and possibly furniture-making.

Overall, the evidence for resource availability is rather complex, especially because it is drawn from an elite site. Some of the lines of evidence seem to contradict each other. For example, the evidence for cultivation with some irrigation suggests that increasing salinization of the soil could have been a problem; however, the increasing cultivation of wheat suggests that it was not. Also, the strong environmental signature indicating that the area around Siddi was not forested and was instead covered with scrub suggests that *Prolagus sardus* should have been the most common wild species at the site; however, red deer, which are forest dwelling, are almost as common numerically. Both of these complexities may relate to the elite status of the site's inhabitants. Elites may have been able to command wheat in spite of the difficulties created by increasing salinization. Elites may also have engaged in hunting expeditions to more distant, forested areas to obtain red deer as a status symbol. These possibilities will be discussed in more detail below. As a general analysis, the evidence suggests that resource availability was fairly high in the Siddi area, with timber being the one resource that was quite scarce. Taken in conjunction with the evidence for the subsistence base, which could, for the most part, be pursued fairly easily in the resource environment indicated for the Siddi area, resource availability should be considered to be high to moderate (see Table 15), locating the community of Siddi in the top half of the y-axis of the proposed model (see Figure 6).

Table 17: Archaeological evidence for resource availability on and around the Siddi Plateau

Resource	**Excavated Evidence**	**Survey Evidence**	**Probable Availability**
Soil	Palaeobotanical remains indicate cultivated, disturbed ground; presence of sedge seeds and phytoliths as well as multicell phytoliths suggest that some irrigation may have been used; increasing cultivation of wheat suggests that increasing salinization of the soil was not a problem	None currently available	High to moderate
Timber	Wood charcoal indicates expedient use of small, maquis species; palaeobotanical remains and phytoliths suggest burning of fodder or dung for fuel	N/A	Low

Animal resources	Wild birds, *Prolagus sardus*, and red deer are relatively common in the faunal assemblage	N/A	High

APPLYING THE MODEL: ARCHAEOLOGICAL CORRELATES

Given the background information on the key components of the proposed model - producer mobility, subsistence base, and resource availability - that is available from Sa Conca Sa Cresia, we would expect to find the elites of Sa Conca Sa Cresia using the strategies and facing the problems shown in the upper left quadrant of the model (see Figure 7). This situation, one of initial economic alienation or of growing social complexity and the beginnings of circumscription, should pertain at least to the earliest archaeological levels at Sa Conca Sa Cresia and may pertain to the entire occupation of the site, depending on the environmentally specific recursive relationships among elite strategies and the key components of the model.

It is important to keep in mind, however, that the beginning of the Nuragic culture, identified by the appearance of nuraghi, does not necessarily mark the beginning of the processes of power consolidation observed in the model. The very appearance of monumental structures associated with small segments of the population indicates that some level of strategizing had already been successful. Whether this successful strategizing indicates powerful lineage heads or genuine incipient elites is difficult to address because of the relative scarcity of known Early Bronze Age sites and the fact that most known sites are mortuary sites, severely limiting the types of questions that can be asked successfully of Early Bronze Age society (see Chapter 6). However, taking into account the likelihood that incipient elites in the Siddi area had been strategizing to consolidate their power possibly for several centuries, we should remain aware of the possibility that Sa Conca Sa Cresia's Nuragic leaders may have been an incipient elite already facing some kind of circumscription.

DIACHRONIC COMPARISON

Comparing the three main phases at the site diachronically can help locate the

activities occurring at Sa Conca Sa Cresia with respect to the proposed model. The main points of this discussion are organized and summarized below (see Table 16). Some strategies such as agricultural extensification and intensification are inherently

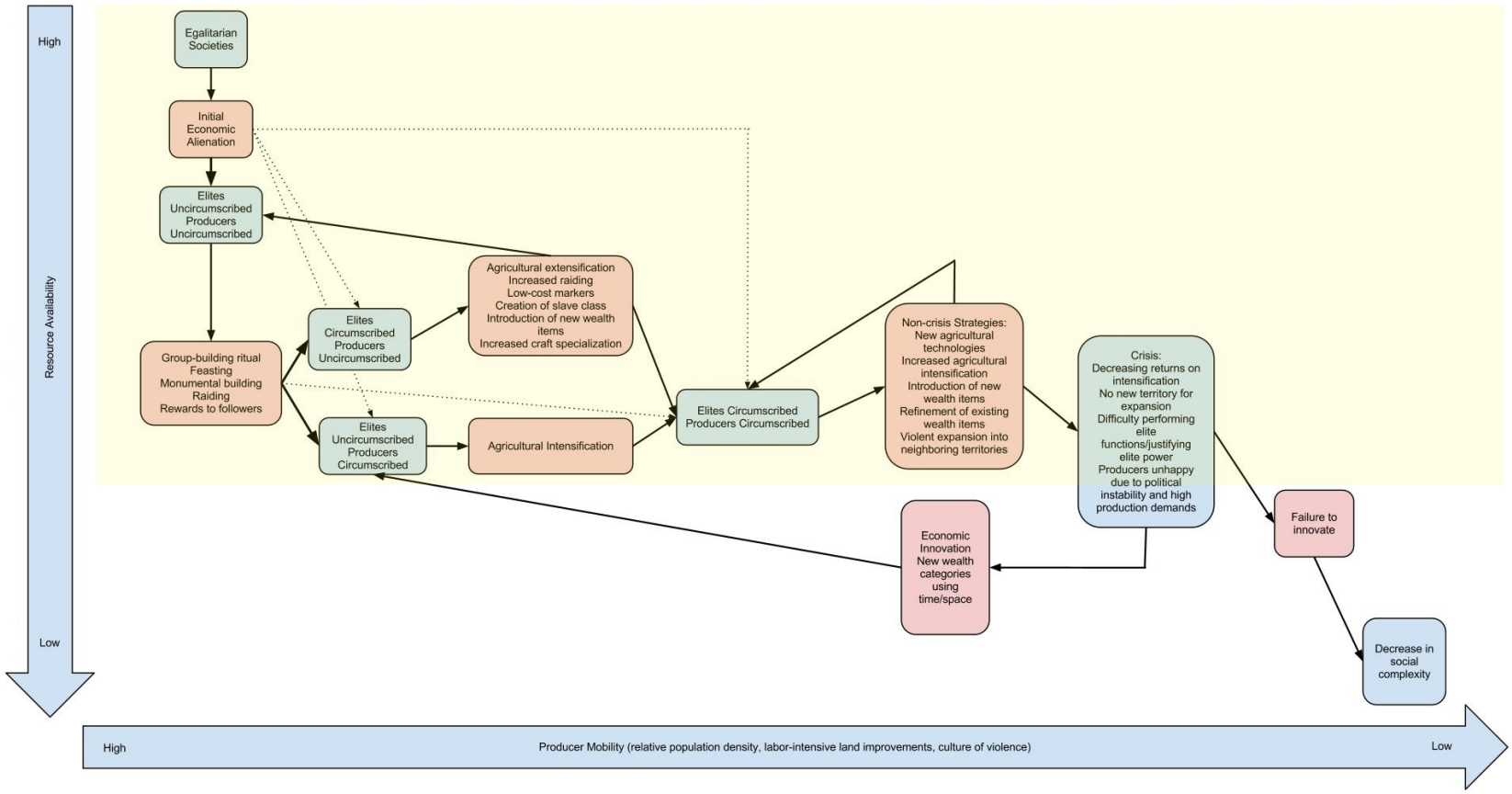


Figure 6: Economic model of social complexity with upper half of y-axis shaded.

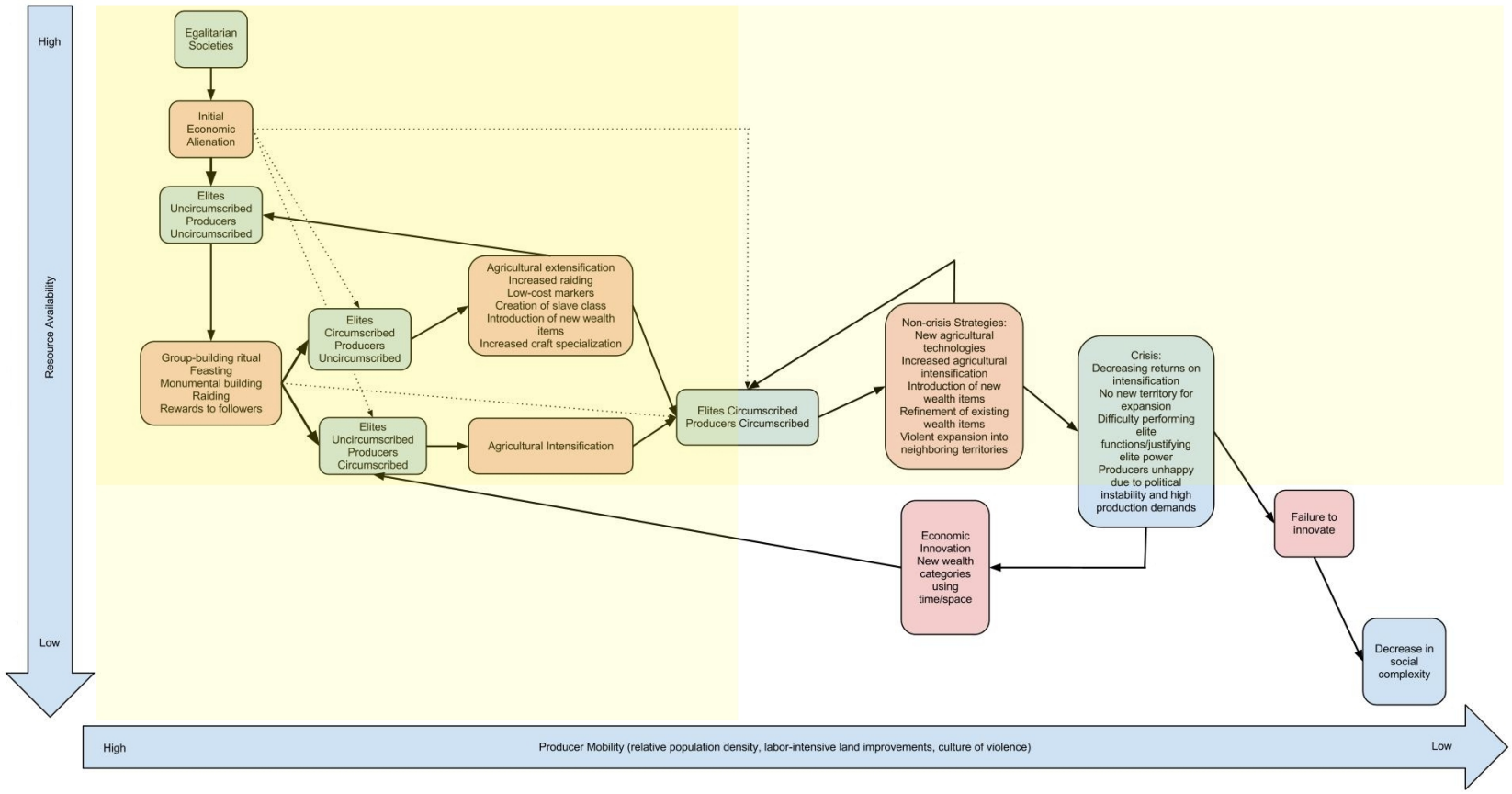


Figure 7: Economic model of social complexity showing overlapping shaded areas highlighting upper left quadrant.

comparative; evidence for these strategies cannot be evaluated for the first phase of occupation at the site because the first phase sets the baseline for comparison. In these instances, the relevant box in the table is marked "N/A." If no evidence bearing on a particular strategy is available, the relevant box is marked "Cannot be evaluated with current evidence." Finally, if evidence bearing on a particular strategy is available but indicates that the strategy was not in use, or if the research methods employed could reasonably have been expected to produce evidence for a particular strategy but did not, the relevant box is marked "No."

It is also important to remark at the outset that, due to the small sample sizes involved, very few of the possible changes identified as occurring among the three phases can be demonstrated statistically. The changing preferences for particular animal and cereal species were found to be statistically significant. Other "increases" in evidence for particular strategies are based on counts or densities that are too small to show significant differences. Further research will be necessary to demonstrate these patterns securely.

The available evidence suggests that some elite strategies were already well established by the time the Nuragic culture on the Siddi Plateau was established (or became archaeologically visible). Basic elite strategies such as the establishment of elite identity and the simultaneous promotion of group identity can be identified in the residential segregation and monumental building of the nuraghi as well as in the monumental building, burial segregation, and group-centered ritual represented by the giant's tomb. Raiding may also have been an elite strategy from the beginning, given the defensive locations of the Nuragic architecture. It is worth remembering that an earlier giant's tomb was in use in the lowlands until the end of the Early Bronze Age, and the events of the Middle Bronze Age included the shift of this monumental burial architecture and its associated rituals and symbolic meanings to the top of the plateau. While this surely served the elite's designs to co-opt and control ritual for their own purposes, the fact that the elites were able to justify the move in the first place suggests that other factors made the wholesale displacement of the community's ritual life desirable.

Craft activities took place at Sa Conca Sa Cresia from its earliest occupation. Artifactual finds indicate pottery and cloth production as well as the procurement and

working of obsidian using techniques, and probably procurement strategies and/or exchange relationships, that had been maintained in the area since the Neolithic. The presence of fine wares in the earliest layers at Sa Conca Sa Cresia suggests that feasting may have played a role in Nuragic elite strategizing from the beginning. Early subsistence strategies included both hunting and animal husbandry as well as wheat and barley agriculture, with cereal processing taking place onsite.

The strategies of residential and mortuary segregation, monumental building, and group-building ritual that were present from the beginnings of the Nuragic community appear to have continued in use into the pre-metalworking phase and indeed throughout the post-metalworking phase as well. In general, few changes in strategies appear to have taken place between the earliest phase at Sa Conca Sa Cresia and the pre-metalworking phase. Feasting practices may have expanded to include coastal imports, as evidenced by two marine bivalves found in the pre-metalworking phase. However, coastal resources are know from some inland Neolithic sites in Sardinia, so it is difficult to say if the consumption of marine bivalves is an innovation of the pre-metalworking phase at Sa Conca Sa Cresia, or if the Neolithic, Eneolithic, and Early Bronze Age ancestors of the Nuragic community on the Siddi Plateau were already in the habit of procuring coastal resources. It is worth noting that the nearest coast, the southern shore and inlet of the Bay of Oristano, lies about 25 km west of the Siddi Plateau in the same general direction as Monte Arci, the obsidian source 15 km to the northwest. The presence of obsidian and marine bivalves in the earliest phase and the pre-metal working phase show a consistent northwest-west orientation of the catchment for imported resources.

Changes in elite strategies between the pre- and post-metalworking phases at Sa Conca Sa Cresia are more noticeable, and changing patterns of food production are particularly interesting considered against a background of environmental change. Although the evidence should not be over-interpreted, a decrease in the amount of six-rowed barley and an increase in the amount of two-rowed barley between the pre- and post-metal working phases may indicate a general drying of the local environment, because two-rowed barley is more drought-tolerant than six-rowed barley (Dighton and Fairbairn 2012). This interpretation would be compatible with the evidence from the wood charcoal, which also suggests that there was not enough water on the Siddi Plateau

to support deciduous species or large tree growth (Veal 2012).

In the context of a drying environment, the changes in food choices that also occurred between the pre- and post-metalworking phases are quite meaningful. While wheat was already the dominant cereal crop in the pre-metalworking phase, the strength of this preference increased in the post-metalworking phase. Increased emphasis on wheat in the face of a drying climate may have necessitated the introduction of some intensive agricultural methods such as canal irrigation, and there is evidence for the use of sedges at the site (Dighton and Fairbairn 2012; Marsh 2012) as well as freshwater diatoms and sponge spicules in the soil samples and some extra large multicell phytoliths, which tend to be caused by irrigation (Marsh 2012). Where this irrigation could have taken place is an excellent question. There are only two water sources on the Siddi Plateau, both small springs, one of which was built into an early sacred well, making the water difficult to access. While it is possible that either spring could have been used for irrigated crop agriculture, it also seems probable that seasonal streams or rivers off the plateau could have been more convenient sources of water for canal irrigation. The nearest small streams to the Siddi Plateau run to the west of the plateau from the north toward the southwest, about 2 km from the plateau's westernmost points. This suggests that the production activities that supplied the crops at Sa Conca Sa Cresia may have been taking place at some remove from the site.

A similar conclusion is suggested for the animal resources being used at Sa Conca Sa Cresia. All three of the expected domesticates are represented in both periods of occupation at the site, as appears to be normal for Nuragic sites given the limited evidence available. In the context of a drying climate, as may have occurred in the Siddi area during the Middle Bronze Age, we would expect sheep/goats to become increasingly important at the expense of animals that require more water and shade, such as pigs and cattle. However, there is a statistically significant increase in pigs between the pre- and post-metalworking phases at Sa Conca Sa Cresia, which suggests that a preference for pork may have outweighed the increasing difficulty of raising the animals. Pig husbandry may have been taking place off the plateau in an area with better hydrology supporting some forest growth. It is interesting to note that oak species, which are currently common on the plateau, are not found among the excavated wood charcoals from Sa Conca Sa

Cresia until the post-metalworking phase, coinciding with the increased emphasis on pigs. Perhaps oak firewood from the area where the pigs were being raised was brought to Sa Conca Sa Cresia along with the animals themselves.

An increase in the catchment area of Sa Conca Sa Cresia is also indicated by marine resources, lithic raw materials, and by the development of metalworking itself. Four marine bivalve shells were found in the pre-metalworking phase, while seven were found in the post-metalworking phase, giving a slight indication that contact with the west coasts increased over time. While the procurement of obsidian from Monte Arci, about 15 km to the northwest, remained constant over the site's occupation, the procurement of attractive chalcedonies from Monte Gringhine, about 25 km to the north, began only in the post-metalworking phase. Finally, the nearest sources of both copper and tin ore lie roughly 35 km to the southwest. With the exception of the single porphyry mace head from Arbatax found in the pre-metalworking phase, which cannot be considered indicative of regular contact, the procurement of metal ore represents the longest regular journey to procure resources that the Nuragic community of Sa Conca Sa Cresia undertook.

Interestingly, there is no evidence that journeys to the south were likely before the post-metalworking phase. Few resources lie to the south, with the exception of the open plains of the Campidano, which could have provided good farmland for unirrigated crops but which do not seem to have been of much interest to the Nuragic people of the Middle Bronze Age, given that few early nuraghi are found there. Engaging in ore procurement probably represents a new orientation for the Nuragic community of Sa Conca Sa Cresia. They would have had to learn about and explore the regions to the south and figure out where ore resources could be procured. Also, the absence of obviously Nuragic communities in the Campidano at this time does not necessarily mean the region was uninhabited; the Nuragic people of Sa Conca Sa Cresia would have had to establish any necessary social relationships required to allow safe passage through the Campidano on their way to procure ores.

The development of metalworking at Sa Conca Sa Cresia therefore represents more than the adoption of a previously unused technology. It represents the gathering of new information, a new geographical orientation, an expanded resource catchment, and

probably new social relationships. Given these logistical accomplishments, the adoption of metalworking is also likely to represent an increase in the political power of the elites living at Sa Conca Sa Cresia that began before the evidence of metalworking itself becomes visible in the archaeological record. Access to and control of the products of metalworking probably served to reinforce and cement increases in political power that had already begun.

There is some indication that the increases in political power achieved by the inhabitants of Sa Conca Sa Cresiainvolved referencing violence or actually engaging in it. The number of mace head fragments goes up from one to two between the pre- and post-metalworking phases. The number of projectile points also goes up, from one to five, also suggesting that symbolic or real violence may have played an increasingly important role, though projectile points may also indicate the development of hunting as an elite activity. It is difficult to be confident about the meaning of the projectile points, because projectile points have not previously been identified as occurring in stratified Nuragic contexts and are not considered artifact types that Nuragic people made. However, if Neolithic projectile points were being collected and kept, it suggests that some symbolic meaning was attached to them.

A final possible indication that the threat of violence continued to play a role for the Nuragic community of the Siddi Plateau is the nuraghi themselves. The existing nuraghi continued to be occupied and elaborated throughout the Middle Bronze Age, and new nuraghi were built on the plateau rather than off it, passing up the opportunity to move closer to desirable resources such as the water necessary for raising wheat and pigs. The convenience of nearby building materials cannot fully explain the Middle Bronze Age focus on the plateau, because Late Bronze Age nuraghi both in the general area of Siddi and in other areas of Sardinia tended to be built in lowland areas farther from sources of building stone than their Middle Bronze Age predecessors. The choice of the Middle Bronze Age community of the Siddi Plateau to continue building elite residences on the plateau while simultaneously shifting their economic activities further away from it may suggest that the threat of violence remained an important motivator throughout the plateau's occupation. However, an alternative explanation could be that the symbolic importance of having leaders live on the plateau was the reason for the nuraghi’s location,

not the threat of violence.

Craft production may have increased at the site from the pre- to the post-metalworking phase, though the small numbers of objects and the different formation processes of the deposits involved do not allow this assertion to be made securely. The only loom weight from the site was found in the post-metalworking phase (Image 49), and the number of spindle whorls increased from two to fifteen, suggesting an increase in cloth production. Also, smaller-diameter spindle whorls were found in the post-metal working phase than were found in the pre-metalworking phase, suggesting that cloth production may have become finer, though the sample sizes involved are far too small to evaluate this possibility statistically. A small increase in the number of burnishing stones may also indicate more or finer pottery production, and the only decorated pottery found in stratigraphic context at the site comes from the post-metalworking phase. Three bone tools and two bone beads were found in the pre-metalworking phase while seven bone tools and one bone bead were found in the post-metalworking phase. Finally and somewhat obviously, the Nuragic elites of the post-metalworking phase had more reliable access to metal, and the only metal artifact found in stratigraphic context at Sa Conca Sa Cresia comes from the post-metal working phase.

There also appears to be a change in the organization of processing activities between the pre- and post-metalworking phases. In both the beginning phase and the pre-metalworking phase, charred chaff remains were found in the flotation samples along with grains and seeds. No chaff remains were found in the flotation samples from the post-metal working phase. This indicates that the primary processing of grain began to take place elsewhere during the post-metalworking phase. This may simply indicate that primary processing moved to an unexcavated area of the site, or it could suggest that grain began to reach Sa Conca Sa Cresia with the primary processing already completed. If wheat was being grown in irrigated fields off the plateau, producers may have been expected to thresh the wheat before delivering it to the elites at Sa Conca Sa Cresia.

Although the evidence for change over time at Sa Conca Sa Cresia is generally too sparse to allow for statistical comparison, overall patterns do seem to be suggested. First, elite strategies that are important in the beginning of the Nuragic occupation of the Siddi Plateau remain important throughout the Middle Bronze Age. The elites of Sa

Conca Sa Cresia added to their repertoire of strategies over time, but did not abandon their earlier strategies.

Second, new resources were incorporated into the political economy over the course of the Middle Bronze Age. Metal ores, particularly of copper but possibly also of tin, were procured and processed to produce copper and/or bronze artifacts, and attractive chalcedonies from Monte Gringhine were procured and used in addition to obsidian. Craft production at Sa Conca Sa Cresia may have increased somewhat and become more specialized, though this change is only hinted at by the current evidence. It may be that a full study of the pottery will confirm this pattern at least for pottery production, but the current evidence is only anecdotal and the preliminary pottery study performed on rim sherds does not show any significant changes.

Third, the political power of the Sa Conca Sa Cresia elite does seem to increase over time, as indicated by expanding resource procurement catchments. However, this increase in political power does not seem to indicate that the elites of Sa Conca Sa Cresia had succeeded in unifying neighboring groups to the point of decreasing the threat of violence. Probably, their increase in political power took the form of building new relationships with more distant neighboring groups, relationships that were often cooperative but that could become competitive rapidly and unexpectedly.

Finally, subsistence strategies appear to have become more strongly tied to the political economy. Food preferences shifted toward crop and animal species unsuited to the maquis-covered plateau and the increasingly dry environment. Elite preference may have been driving this shift in food choice, and in response, production seems to have moved farther away from the plateau toward forests and wetter areas where canal irrigation could be practiced.

Table 18: Archaeological correlates of the proposed model applied to the Siddi Plateau community

Growing Social Complexity and the Beginnings of Circumscription				
Strategy	**Indicator(s)**	**Nuragic Beginnings**	**Pre-Metalworking**	**Post-Metalworking**
Group-building ritual	Public areas for ritual activity	* Giant's tomb with forecourt for public ritual built	* Probable continued use of forecourt of giant's tomb	* Probable continued use of forecourt of giant's tomb

Feasting	Display-oriented eating paraphernalia	* Presence of fine ware may suggest that feasting is part of early Nuragic culture	* Four marine shells	* Seven marine shells * Increased emphasis on wheat * Increased emphasis on pigs
Monumental building	Projects requiring pooled labor at levels greater than that of the household	* Giant's tomb * The foundation of at least Sa Conca Sa Cresia and Sa Fogaia	* Remaking of the corridor structure into a naviform room * Additional building events including tower and refacing wall may date to this period	* Additional building events including tower and refacing wall may date to this period
Raiding	Site/house destruction; high levels of violence	* Defensive locations chosen for nuraghi/giant's tomb	* Continued use of defensive structures *One fragment of a mace head * One projectile point	* Continued use of defensive structures * Destruction of Sa Conca Sa Cresia habitation area during middle and at end of phase may be result of raiding * Two mace head fragments * Five projectile points
Rewards to followers	Access to special foods/products; ownership of display items	Cannot be evaluated with current evidence	Cannot be evaluated with current evidence	Cannot be evaluated with current evidence
Established Social Complexity and Growing Circumscription: Elites Circumscribed, Producers Uncircumscribed				
Strategy	**Indicator(s)**	**Nuragic Beginnings**	**Pre-Metal Working**	**Post-Metal Working**
Agricultural extensification	Land clearance without change in agricultural strategies	N/A	* Wild and cultivated grass phytoliths covary, indicating that both types of plants entered the deposits together	* Wild and cultivated grass phytoliths covary, indicating that both types of plants entered the deposits together * Increase in weed seeds, particularly those associated with disturbed and cultivated ground
Low-cost status markers	Development of residential and/or mortuary segregation	* Nuraghi indicate residential segregation * Giant's tomb may indicate burial segregation	* Continued use of nuraghi	* Continued use of nuraghi
Creation of slave class	Appearance of extremely poor residences and/or burials; appearance of new ethnic group(s)	Cannot be evaluated with current evidence	Cannot be evaluated with current evidence	Cannot be evaluated with current evidence
Introduction of new wealth items	Appearance of previously unattested labor-intensive or non-local goods	N/A	* First appearance of marine bivalves at the site * Two bone beads	* Green chalcedony core * One bronze artifact * One bone bead

Craft specialization	Refinement or elaboration of existing craft items	* One spindle whorl fragment * One burnishing stone	* Two spindle whorl fragments * Two burnishing stones * Three bone tools	* Fifteen spindle whorl fragments * One loom weight * Four burnishing stones * Decorated pottery * Seven bone tools * Development of copper or bronze working
Established Social Complexity and Growing Circumscription: Elites Uncircumscribed, Producers Circumscribed				
Strategy	**Indicator(s)**	**Nuragic Beginnings**	**Pre-Metal Working**	**Post-Metal Working**
Agricultural intensification	Establishment of land improvements; intensive farming methods	N/A	* Presence of large multicell phytoliths late in phase may indicate introduction of irrigation	* Decrease in six-rowed barley with respect to two-rowed barley may indicate a drying climate; simultaneous increase in wheat agriculture may indicate that some use of irrigation was necessary
Political Economy In Crisis: Elites Circumscribed, Producers Circumscribed				
Strategy	**Indicator(s)**	**Nuragic Beginnings**	**Pre-Metal Working**	**Post-Metal Working**
Use of time/distance as a resource	Visible accumulations of time; elite references to having traveled great distances or having knowledge or control of far-away places	No	No	No

EVIDENCE FOR FAILURE?

A main concern of this study is to identify ways in which the interactions among resource use and political economy may have been unsustainable even at low levels of social complexity. In this sense, sustainability is thought of as an interaction of environmental and social systems. Environmental sustainability is defined by what the environment can bear in terms of regeneration of resources without noticeable damage to the resource base. Social sustainability is defined by what the social structure itself can bear in terms of stresses and shocks to its systems of production and distribution of goods, including its ability to rationalize and diffuse the social meanings and tensions that accompany noticeable disruptions in these systems. For a political economy to be sustainable, the environmental component and the social component must be in some

kind of balance.

The settlement trajectory of the Nuragic community of the Siddi Plateau suggests that something about its political economy was not sustainable. In a few centuries, sixteen megalithic monuments were built on the plateau. A seventeenth was begun but never finished, and there is currently no evidence that Nuragic occupation continued on the plateau after the Middle Bronze Age. Two small tholos nuraghi located to the southeast of the plateau provide evidence that some part of the Siddi Plateau population may have moved into the lowlands at the beginning of the Late Bronze Age, but together these two new nuraghi do not equal the labor expended on the earlier corridor nuraghi and giant's tomb on top of the plateau. Even if two additional nuraghi located further to the south near the modern town of Villanovaforru are considered part of the new settlement system, the labor expended still fails to equal that of the former settlement.

Was the disruption, loss of population, and subsequent reorganization in the Siddi area a result of an unsustainable political economy, or was the community subject to some other stress, perhaps increasingly violent competition from its neighbors on the Gesturi Plateau 10 km to the northeast? Evaluating whether the community of Siddi succumbed to increased raiding will require further excavation in the area, preferably also of producer villages if they can be located. However, there does appear to be some evidence that the political economy of Nuragic Siddi may have been headed in an unsustainable direction. The increasing preference for pigs and wheat suggests that these foods were higher status foods, probably the foods preferred for feasts and the foods that elites were expected to supply when motivating the labor necessary to build or expand the nuraghi. Pigs and wheat both require more water to raise than do the available alternatives of ovicaprids and barley. Focusing on water-intensive feasting foods seems to have had the affect of moving agriculture off the plateau and encouraging experiments with irrigation. Extensification also seems to have occurred, given the large increase in field weed seeds over the course of the site's occupation.

Strategies of extensification and irrigation may have proved problematic in a mostly-unforrested Mediterranean environment with a simultaneously drying climate. Extensification could have overtaxed soil nutrients, and if dung was indeed being collected and burned as fuel, very little of it may have been returned to the fields to

maintain soil fertility. Additionally, areas that were being irrigated would have been susceptible to salinization, particularly with the high rates of evapotranspiration that would have accompanied a drying climate (Marsh 2012). The poor hydrology of Sardinia suggests that irrigated soils, which are likely to have occurred near small, seasonal streams, would not have received much replenishment from seasonal flooding.

Low-level difficulties such as those described above would probably not have proved problematic in a matter of a few centuries for a community in which producer mobility was more circumscribed, but the community of Siddi appears to have been expanding its networks during the Middle Bronze Age. Knowledge of areas to the north, west, and south and pre-existing relationships with the communities there may have made it easier rather than harder for unhappy producers to leave the Siddi community. Attempts to get producers to practice irrigation may have met with resistance, and decreasing yields over time may have created further frustration. Having to move farther away from the plateau to farm, a likely outcome of both extensification and intensification, may also have made producers uncomfortable in a region in which the threat of violence may have been a concern.

In sum, the sustainability obstacles encountered by the elite of the Siddi Plateau community were probably not pronounced. In a situation of high producer circumscription, the Siddi elites could probably have forced greater input in irrigation, possibly accompanied by still more extensification, without truly exhausting and over-salinizing the soil at least into the Late Bronze Age. However, the producers of the Siddi Plateau were not highly circumscribed. Siddi producers were probably only slightly circumscribed, meaning that small increases in labor demands and small decreases in agricultural productivity could have been destabilizing.

CONCLUSIONS

The current evidence for elite strategies, political economy, and environmental change in the Middle Bronze Age community of the Siddi Plateau is not conclusive. Further analysis of the materials excavated by Progetto Pran'e Siddi will need to occur, and further excavation and survey will also be necessary to expand sample sizes, address

seeming patterns that may be artifacts of the spatial organization of Sa Conca Sa Cresia, reconstruct environmental change more securely, and recover evidence for non-elite strategies and responses. However, the current evidence does allow for some fairly secure conclusions and suggests others that will form the research questions for future projects.

The Nuragic community of the Siddi Plateau can be located within the model with reasonable confidence. A variety of evidence indicates that the producers of the Siddi community were only moderately circumscribed, if at all, and the evidence for the availability of resources indicates that, at least in the beginning, resources were widely available. This locates the Siddi community within the top left quadrant of the proposed model, predicting elite strategies based primarily on strategies of motivation, elite identity, and community building. To continue pursuing these strategies without becoming circumscribed themselves, elites probably felt pressure to expand agricultural strategies to produce more food for feasts, and expand craft specialization and introduce new wealth items to reinforce elite identity and provide possible rewards for followers. Elites may also have increased the amount of raiding they did to bolster their identity and the community's sense of reliance on their leadership. To the extent that data from Sa Conca Sa Cresia show patterns, the patterns indicate that Siddi's elite pursued precisely these strategies.

The political economy of the Siddi community probably fluctuated between an elites uncircumscribed/producers uncircumscribed situation and an elites circumscribed/producers uncircumscribed situation. Evaluated in terms of sustainability, these situations are likely to lead to large shifts in the balance of power as incipient elites try to come up with the resources necessary to compete for followers. Attempts to institute more intensive production methods may rapidly backfire as producers resist the greater demands on their time while simultaneously becoming disenchanted with the decreasing impressiveness of their elite's displays. The introduction of new wealth items may bolster elite identity and allow a shift in the producer rewards system from being feasting-based to being valuable-based, but only if the valuables can be obtained in a quantity sufficient to save the most numerous and best items for the elites while distributing small quantities or inferior items to the producers.

Given the delicacy of such a system of motivation and reward in which the

producers more or less control whether the system will continue, it is perhaps not surprising that the Nuragic community of Siddi lasted only a few centuries in its most organized state. Even small disruptions in the flow of goods could be cause for discontent, as could small increases in the demand for labor, especially if the extra labor was not perceived as being adequately compensated through feast, rituals, or protection. Failures to continue complex political economies and the fluctuations in power that accompany such failures are probably far more frequent outcomes than their successful maintenance and growth.

Chapter 9: Discussion and Wider Implications

INTRODUCTION

The results from the preceding study have broad implications for understanding the overall trajectory of the Nuragic culture, as well as the place of Sardinia and the Nuragic culture within wider pan-Mediterranean Bronze Age networks and events. While not all of these implications can be discussed here, this chapter will briefly address some of the main points of relevance my work has for understanding the island-wide Nuragic culture of the Middle Bronze Age, the overall trajectory of Nuragic sociopolitical organization, and the relationship of West Mediterranean cultures to East Mediterranean cultures during the Bronze Age.

THE SIDDI PLATEAU IN THE SARDINIAN MIDDLE BRONZE AGE

Although the formation, growth, and subsequent decline of the Nurgaic community of the Siddi Plateau is only one example of a Middle Bronze Age community, it can be used as a starting point for building an overall picture of the functioning and interaction of communities in the beginning of the Nuragic culture. While any model proposed will have to be independently tested through further investigation of Middle Bronze Age communities, an understanding of how the community of the Siddi Plateau operated considered in context with existing archaeological data can provide a good starting point.

To begin, two types of archaeological evidence should be considered together: the corridor nuraghi and pottery styles. The evidence of the corridor nuraghi and the evidence of Nuragic pottery styles give two different signatures for what was going on in Sardinia in the Middle Bronze Age. The corridor nuraghi, of which there are very few known, are mostly concentrated in the center part of the island, give the impression that the development of the Nuragic culture was localized and that many communities on the

island did not participate in it at first. However, the evidence of the pottery suggests the opposite. Some pottery styles are shared island-wide starting in the Middle Bronze Age, suggesting that the entire island was again linked through interaction networks of some kind for the first time since the Neolithic Ozieri culture. Though some Nuragic pottery styles show a distinct north-south regional divide, this pertains primarily to surface decoration and treatments rather than to vessel shapes.

Interpreting these two phenomena requires thinking about the nature of early Nuragic elites and their strategies for legitimizing their newly claimed elite status. Evidence from the Siddi Plateau strongly suggests that these strategies of legitimation were not yet based on impressive displays of fine craft goods or acts of conspicuous consumption. While there are hints that such strategies were being developed during the course of Sa Conca Sa Cresia's occupation, the evidence from the Siddi Plateau indicates that elite strategizing focused on emphasizing the elite's role as community leaders. In particular, the act of appropriating the cult of the giants' tomb, probably an ancestor cult, and moving it onto the plateau where it was recreated in close proximity to elite residences using the architectural style of elite residences shows an impressive ability to organize and motivate labor as well as the political power to disrupt previous cult practices and reshape them with greater reference to the elite. However, the need to maintain the cult of the giants' tomb in some form also highlights the fragility of early Nuragic elite power by demonstrating that it required links to familiar and accepted sources of authority and veneration to function. Finds of pottery vessels buried in the forecourts of giants' tombs, including Sa Domu 'e S'Orcu on the Siddi Plateau (M. Perra, pers. comm.), suggest that rituals and feasts were still focused on community-building and emphasizing elites as community leaders rather than on emphasizing elite separateness and privilege.

Given that community ritual was probably small scale and inward-focused at this time, the question of how pottery styles became island-wide again during the Middle Bronze Age remains. Two processes probably contributed to the development of island-wide pottery styles. The first is greater ranges for the regular procurement of resources. While obsidian is found all over Sardinia in Neolithic contexts, it is usually found in smaller proportions to local stone if good flaking stone is available locally. In the Middle

Bronze Age and later, obsidian is preferred to other local stones all over the island, showing an increase in the range and frequency of procurement and exchange networks at the beginning of the Nuragic culture. A second increase in procurement ranges, this time to obtain metal ores, can be seen to have occurred during the Middle Bronze Age occupation of the Siddi Plateau and is known to have occurred at other Nuragic sites by the Late Bronze Age.

Creating and maintaining the relationships that allowed these networks to function would have required interacting with any groups in the areas that had to be crossed. It is quite likely that many of these areas were inhabited by groups that had not yet developed the incipient hierarchical social structure of the Nuragic communities, given the small number of corridor nuraghi and their fairly localized distribution. However, interacting with these groups and establishing the right to pass through their territory would still have required negotiation, the exchange of ideas, and probably the exchange or gifting of objects, foodstuffs, or both. The effort of the incipient Nuragic elite to acquire new resources, frequently for use in display as they slowly built their elite identity, would have had the effect of spreading Nuragic material culture throughout the island. Metalworking would have been particularly effective in promoting island-wide networks, because ore resources are found in more parts of the island than the single, localized obsidian source.

Another process that probably led to the spread of Nuragic material culture was intermarriage, though this is a difficult process to detect archaeologically in the absence of well-preserved mortuary deposits. Changing marriage behaviors is a low-cost way of signaling elite identity and separateness in a situation of developing complexity in which low producer circumscription prevents elites from focusing heavily on overproduction to build their identity and power. Selecting criteria for eliteness - such as dwelling in a nuraghe and/or controlling giants' tomb ritual - and then intermarrying only with other families who exhibit the same criteria would emphasize elite identity. It would also have the practical effect of forcing elites to look outside their own community for suitable marriage partners and to travel and settle in new locations once the marriages were arranged. Elite intermarriage would have spread material culture and encouraged the development of some island-wide styles, probably associated with elite behaviors at first

but potentially copied and used by non-elites as well.

The failure of the community of the Siddi Plateau to persist after the end of the Middle Bronze Age indicates that the early growth of the Nuragic culture was a period of political instability. This does not necessarily mean that rates of violence were extremely high, and there is no strong evidence for real or symbolic violence playing an important role in the development of the Siddi Plateau community. It does mean that maintaining control over producers appears to have been difficult and that not all elites were able to achieve the successful political consolidation of their territories. There are only four Late Bronze Age nuraghi in the general area of the Siddi Plateau compared to the sixteen completed monumental structures on top of the plateau, suggesting that not all of the plateau's population remained in the area after the Siddi Plateau community left the top of the plateau. Possibly, the community may have fractured, with some of the population heading south off the plateau to establish a small Late Bronze Age community, locating their settlements so access to water would be easier and perhaps referencing the evidence of their Eneolithic ancestors at Su Cuaddu de Nixias in an attempt to justify their continued elite status. At the same time, some of the plateau's population may have gone north to join the Nuragic communities of the Gesturi Plateau; the settlement system of the Gesturi Plateau saw an important growth in labor capture around the end of the Middle Bronze Age.

THE GROWTH AND DECLINE(?) OF THE NURAGIC CULTURE

The local population decrease that seems to have occurred when the settlement on top of the Siddi Plateau was abandoned does not indicate any great change in the basic social organization of Nuragic culture, only a restructuring of the distribution of population. This restructuring seems to accompany greater political consolidation, as evidenced by the much larger, multi-towered nuragic complexes that were built in some places in the Late Bronze Age. Additionally, more Late Bronze Age nuraghi were built in lowlands, closer to farming resources and forgoing the protective element of the defensible sites preferred in the Middle Bronze Age. Some Late Bronze Age elites tried to solve this problem of greater vulnerability by building circumference walls around their

nuraghi, creating very defensible entrances to the nuraghi, or both, but not all Nuragic elites found it necessary to do so. For example, the nuragic complex at Palmavera (Alghero-SS) has a circumference wall, but the wall is extremely low and would not have provided much real defense. While it is doubtful that the threat of violence went away in the Late Bronze Age, it may have abated somewhat with the larger polities and extended boundaries that came with greater political consolidation.

Elites in the Late Bronze Age appear to have continued pursuing all the same strategies as the Middle Bronze Age elites of the Siddi Plateau, but at larger scales. Monumental building increased, the strong association between elites and giants' tomb ritual continued and became stronger (Blake 1999; 2001), and the development of craft specialization of which we see hints on the Siddi Plateau became more pronounced, with more fine-walled, high-fired, and highly burnished serving vessels being manufactured, though still in the same Middle Bronze Age shapes. There is currently not enough evidence to attempt a study of whether cloth production became finer, but metal working appears to have increased. Metal objects are found more frequently in Late Bronze Age and later contexts, though they are still not commonly deposited.

Two important innovations in elite strategizing occur at the end of the Middle Bronze Age and during the Late Bronze Age. The first is the introduction of East Mediterranean imports. One of the earliest known is a broken aryballos from the foundation of Nuraghe Arrubiu, dated to the end of the Middle Bronze Age. From this moment on, sporadic finds of East Mediterranean ceramics and - significantly - local imitations of East Mediterranean styles are common. These imported and imitation-imported ceramics have been studied by Russell (2010), who found no correlation between the size of the nuraghe where these ceramics were found and the number of ceramics found there, leading him to conclude that: "While extra-insular contacts may have enabled Sardinian elites to appropriate and restrict foreign exotica as one method of differentiation, it seems unlikely that such contacts represented the prime mover in the development of a more rigidly hierarchical society" (2010:112).

While I do not disagree with Russell's assessment that the amount of East Mediterranean ceramics circulating in the Late Bronze Age was not important in supporting a more hierarchical society, I do think that he and scholars like him who have

focused on evaluating how much direct contact the Nuragic people had with the East Mediterranean (Blake 2008) are to some degree missing the point. Having and displaying large amounts of a type of valuable is not the only strategy for using valuables to demonstrate eliteness: rarity and scarcity can be just as strong symbolically, depending on what the valuable references.

I would argue that the incorporation of small numbers of East Mediterranean imports and, more tellingly, imitations of East Mediterranean pottery should be interpreted within the economic model proposed in the current work. The Nuragic elites of the Late Bronze Age were running out of new ways to affirm their eliteness and motivate loyalty. In a landscape in which mobility was still an option for disaffected producers, as the broad population restructuring of the end of the Middle Bronze Age demonstrates, Nuragic elites must have struggled to maintain their power especially as they sought to increase it. The Middle Bronze Age-Late Bronze Age trajectory appears to be one in which elites were caught in a feedback loop in the model, running very hard to stay in one place (see Figure 8).

The adoption of small amounts of foreign imports by Nuragic elites should not be perceived as the introduction of new wealth items but rather as an economic innovation referencing the inexhaustible resource of distance. In this case, the rarity of the objects, which Russell considers an argument against their importance in maintaining hierarchy, is what makes them meaningful and successful as indications of elite identity and difference. The ability of elites to reference knowledge of a far-off land, reachable only by sea travel and probably presented as a land of riches, would have enhanced their prestige and the perception that they deserved their power because of their superior knowledge, control over the foreign and unknown, and quite possibly skill and bravery in going out and acquiring the foreign goods (Helms 1988).

Considered in this light, the argument that East Mediterranean traders probably seldom came to Sardinia themselves is an argument in favor of the importance of East Mediterranean goods in Nuragic hierarchy rather than an argument against it. To make the imports most effective, elites should have had to go on journeys to acquire them, potentially journeys by sea to Sicily, which Russell's work argues may have been the middleman providing the East Mediterranean imports (2010:113). The use of imitations

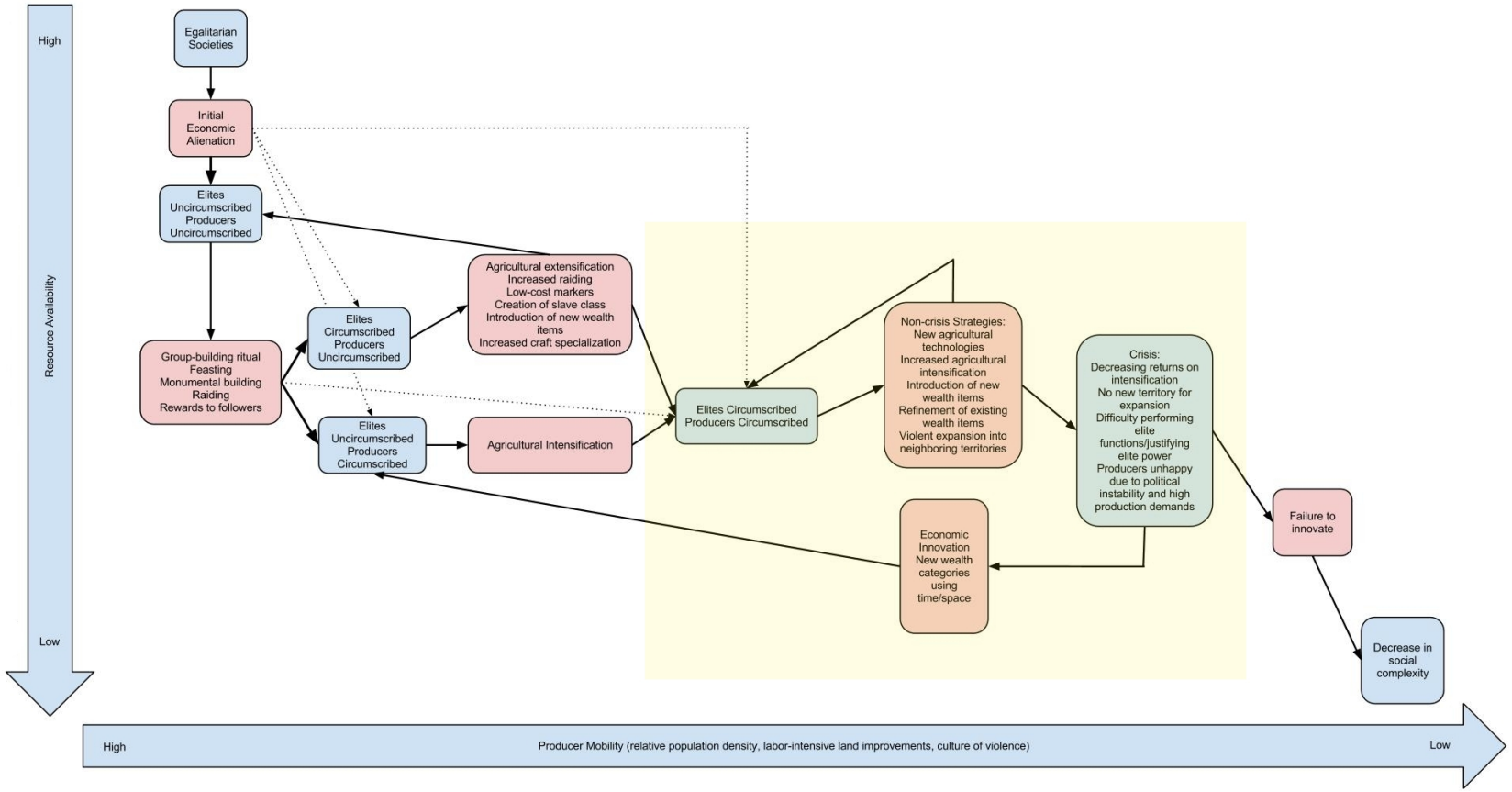


Figure 8: Economic model of social complexity with Late Bronze Age feedback loop shaded.

also makes sense in this context. If the concern was not for the fineness of the object itself or for its possible contents (such as the perfumed oil which was frequently traded in fine ceramic vessels in the East Mediterranean) but instead for the object's reference to foreign lands, a lower-quality, empty imitation could serve the same function as the genuine article. As long as a member of the elite disappeared for a while and then reappeared with a foreign-looking vessel and stories of an amazing journey, the identity-bolstering function of the vessel would be served. Alternatively, local production of East Mediterranean imitations may be interpreted to indicate a change in the meaning of East Mediterranean ceramics. It is possible that, once the possession and use of East Mediterranean-style ceramics became associated with elite identity, these ceramics lost their reference to distance and exoticism, becoming simply another wealth item that could be manufactured locally without damaging their power.

The perpetually low level of social control that the Nuragic elites exercised over their producers is also indicated by the material correlates of the breakdown of hierarchy in the Nuragic culture, which I identify as occurring around the end of the Final Bronze Age and the beginning of the Early Iron Age, depending on which site is being discussed. The Final Bronze Age and Early Iron Age on Sardinia was clearly some kind of transitional period, and it has been the subject of much debate and speculation. It has been interpreted variously as a breakdown of hierarchy, a further consolidation of hierarchy (Perra 2009), and a transfer of hierarchy from political elites to religious elites (Campus, Leonelli, and Lo Schiavo 2010). In most of the literature, the Sardinian Iron Age has been considered a time of cultural continuity from the Bronze Age, based at least in part on Lilliu's assertion that there are no "true breaks" in the chronology seen in the excavations of Su Nuraxi at Barumini (Lilliu 1982).

I would argue that the seeming inability to decide what's going on in the Final Bronze Age/Early Iron Age comes from a failure to adequately define what it means for a society to collapse. This is an instance in which it is essential not to conflate "society" and "culture," words that are often used as synonyms but that, in this case, have very different implications. I would argue that only a society can collapse. Following Tainter (1988), I define collapse as strictly a sociopolitical phenomenon:

> Collapse...is a political process. It may, and often does, have consequences in such areas as economics, art, and literature, but it is fundamentally a matter of the sociopolitical sphere. A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity. (1988:4)

As Tainter makes clear, important aspects used to define and identify a culture - such as economics, art, and literature or, more recognizably for the Nuragic culture, agricultural and pastoral strategies and craft production - are not the criteria by which collapse should be judged. I would argue that what has been confusing scholars in evaluating the end of the Nuragic society is seeing a sociopolitical collapse during which many aspects of material culture showed continuity. However, if one divides the material correlates of Nuragic society into those that are very difficult to achieve outside a complex political organization - nuraghi, giants' tombs, and well temples - and those whose production and replication can be maintained at the level of the household - pottery, agricultural and pastoral practices, spinning and weaving, and small-scale metal production - we see clearly that all the types of material culture that required complexity failed to continue into the Iron Age, while those types of material culture that could be maintained by teaching communities within families did continue. The increased importance of families as learning communities and the basic units of production in the Sardinian Iron Age may be further corroborated by the pronounced change in house structures between the Bronze Age and the Iron Age. Bronze Age houses are predominantly smallish round huts with mostly undifferentiated internal space, while Iron Age houses are large buildings with numerous individual rooms arranged around a central courtyard, suggesting extended families.

The fact that most forms of production in prehistoric Sardinia survived the breakdown of Nuragic society is a strong indication that these forms of production never came fully under the control of the elite. No type of production was specifically the province of the elite. Even metalworking appears to have remained a skill that all could learn, based on the continued production and use of metal objects as votives in the Sardinian Iron Age.

Given that the Nuragic society collapsed around the end of the Bronze Age but much of Nuragic culture continued into the Iron Age, it is something of an academic

question as to whether Iron Age Sardinians who no longer built nuraghi can still be referred to as Nuragic. Personally, I find it strange to apply the term "Nuragic" to people who no longer had the ability to build their eponymous structure and prefer the term Iron Age Sardinians, but it is not an essential question as long as the difference between sociopolitical collapse and cultural continuity is clearly understood.

THE NURAGIC TRAJECTORY AND THE EAST MEDITERRANEAN

One of the questions that presents itself when studying the cultures of the West Mediterranean in their wider Mediterranean context is always: why are they so different? The early development of the palace cultures of the East Mediterranean, with their state-level complexity, large and well-organized political economies, and extremely high levels of craft specialization, stands in stark contrast to the much slower development of complexity in the West Mediterranean, as well as the fact that Western Mediterranean societies do not appear to have reached the same high levels of complexity and craft refinement before the pan-Mediterranean disruptions at the end of the Bronze Age (ca. 1150-1000 BCE).

It is tempting to explain the differences between the East and West Mediterranean through culture contact; the East Mediterranean societies became more complex more quickly because they had more contact with the already highly complex societies of the Near East and Egypt. However reasonable this argument may appear on the surface, it is ill-defined and ultimately teleological. It invites the scholar to trace it infinitely backward, asking why the societies of the Near East and the Levant became so complex so quickly after the Neolithic Revolution, or to trace it forward, asking why contact with the East Mediterranean palace societies and the societies of the Levant, which was clearly happening in Sardinia at least by the end of the Middle Bronze Age, did not cause a rapid increase in Sardinian complexity and specialization. Additionally, arguments about why complexity did not develop so completely in the West Mediterranean even after contact with the East usually rely on vague explanations involving the West Mediterranean being "too marginal" (Rowland 2001). Clearly the differences between West and East Mediterranean deserve more careful consideration and a more genuine explanatory

framework. I propose that the current study provides just such a framework.

First, it is important to remember that allowing social complexity to develop is a choice that communities make (see discussion in Chapter 2). Complexity is not simply a natural outcome of long-lived human societies, and in evaluating the development of complexity in the Mediterranean in general and in the West Mediterranean in particular, it is important to look first for reasons why early Mediterranean societies would have resisted the development of complexity. The domestication of plants and animals is clearly related to the development of complexity in the Near East, and the Neolithic Revolution is rapidly followed by widespread sedentism, storage, and complexity. However, this trajectory does not appear to be so clear-cut once domesticates spread outside of the Near East. For example, domesticated crops arrive on Sardinia by 5650 cal. BCE (Skeates 2003:172), but complexity only begins to develop four thousand years later, and then slowly.

It has been argued that, in the Near East, the adoption of private storage broke down publicly-enforced sharing behaviors (Flannery 2002) and the limited amount of land that was appropriate for raising domesticated crops further concentrated wealth in the hands of a few (Flannery 1969). The reasons why reliance on domesticated crops did not necessarily lead to the rapid development of complexity in other areas of the world may have to do with the fact that the conditions of the Near East are not found in most areas into which Near Eastern domesticated crops spread. Agriculturally viable land is not so concentrated outside of the Near East, particularly in Europe, so the ability to control food-producing territory is much less likely to have been a source of political power in Neolithic Europe, including the Mediterranean.

In addition to the fact that food production was not likely to be easily controlled in Neolithic Europe, there are also reasons why sharing behaviors may have taken longer to break down, particularly in the Mediterranean. While much of the land in the Mediterranean would have been suitable for agriculture during the Neolithic and afterward, this does not necessarily mean that the yields from all fields would have been consistently similar. The effect of microclimate on Mediterranean production must be considered in terms of its potential social outcomes. Microclimatic effects on agricultural production are well known and documented in the Mediterranean (Halstead 1990:147–

148, 155), with the result that resource availability would have remained patchy and unpredictable even after the adoption of agriculture. This patchiness and unpredictability of crop yields, which to some extent mimics the patchiness and unpredictability of resources experienced by many forager groups, may have been particularly important in encouraging early agriculturalists in the Mediterranean to actively maintain an egalitarian ethos emphasizing sharing and discouraging the accumulation of personal surpluses. Even the adoption of private storage, which is practiced by many forager groups, would not have been sufficient to erode sharing behaviors if they were actively practiced as a way of managing microclimatic variability in crop production.

If we consider that early Mediterranean farmers may have had good reason to practice sharing and maintain an egalitarian ethos even after relying on agriculture for food production, we must look for other ways in which the egalitarian ethos could have broken down. The model proposed and developed in the current work strongly suggests that this breakdown would have been related to the growing circumscription of producers, making them unable to resist when overly aggressive members of their groups violated the egalitarian ethos. There is little evidence that absolute population would have caused producer circumscription in either the East or the West Mediterranean, though the case that the geographical boundedness of the islands of the East Mediterranean may have caused some producer circumscription can be made (however, the argument that the concentration and nearness of the islands to each other acted as an encouragement to travel and seafaring has also been made (Broodbank 2000)). Instead, the cause of producer circumscription must be located in some other factor: relative population density, violence, or the adoption of labor-intensive land improvements for food production.

A strong case can be made that labor-intensive land improvements, broadly conceived, were adopted in the East Mediterranean shortly before the development of complexity and well before comparable labor-intensive land improvments were adopted in the West Mediterranean. It is generally accepted that the cultivation of grapes and olives began in the Caucasus and Levant in the Chalcolithic and spread to the East Mediterranean by the Early Bronze Age (Zohary and Spiegel-Roy 1975). Although contempory DNA studies have suggested multiple origins for both grape and olive

cultivation including domestication events originating in the West Mediterranean basin (Arroyo-García et al. 2006; Besnard and Bervillé 2000; de Caraffa et al. 2002), these West Mediterranean domestication events probably post-date the domestication events of the East Mediterranean and may have occurred in response to contact with East Mediterranean cultivars brought by East Mediterranean immigrants and traders. Further study will be required to verify or refute this possibility, but archaeological evidence does not currently support the widespread use of grape and olive in the West Mediterranean as early as the Early Bronze Age.

How extensively grape and olive were used in the East Mediterranean in the Early Bronze Age is debated (Hamilakis 1999). Archaeological evidence demonstrates fairly intensive use of both resources in the Levant during the Early Bronze Age (Zohary and Spiegel-Roy 1975) and wine culture seems to have been well established at least at Myrtos in Crete by the Early Bronze Age (Warren 1972). However, Hamilakis (1999) argues that wine and olive oil production were not pursued by Early Bronze Age villagers because both were too risky, and therefore grape and olive were not likely to be part of Early Bronze Age subsistence at any large scale, taking hold only after the palace economies of the Middle and Late Bronze Age had developed.

A key part of Hamiliakis' argument that I find compeling is that wine and olive oil probably formed part of elite rituals of feasting, consumption, and bodily adornment that were arenas of competition for the elites, which could explain why both wine and oil production were pursued so intensively by the palace administrations. I find this argument much more compelling than Renfrew's model of specialized wine and olive production creating a need for redistributive managers, thus encouraging the development of social complexity. Ethnographic evidence suggests that overproduction seldom happens in the absence of political motivations encouraging overproduction (Sahlins 1972); it also suggests that so-called redistributive economies are seldom truly redistributive (Gilman 1981), calling into question the genuine benefit East Mediterranean villagers would have gained from allowing the development of a managerial elite.

I also find Hamilakis' argument more compelling than that of van Andel and Runnels (1988), who argue that the development of trade emporia in sites with insecure

subsistence bases created a feedback loop that encouraged more trade, then importation of labor to support the additional trade, resulting in hierarchical structures among those controlling the traded wealth. Like Renfrew, van Andel and Runnels fail to explain why Early Bronze Age villagers would choose to accept subordinate status for the sake of traveling to marginal environments to engage in trade. Without positing either the existence of a slave class or cultural rules like primogeniture that would have created a group of dispossessed people seeking subsistence at any cost, van Andel and Runnels cannot explain the positive feedback loop that their model depends upon. Given that the largest palaces, like that of Knossos, are found in relatively fertile rather than highly infertile and marginal areas, their model seems even more unlikely.

While Hamilakis' model of elite competition in feasting and adornment encouraging overproduction that the elites then controlled makes sense assuming that elites had already been established, what it does not do is explain the development of social hierarchy in the first place. In this respect, I find Hamilakis' argument to miss the mark. Hamilakis argues that the lack of widespread evidence for wine drinking and oil use before the Middle Bronze Age (acknowledging the counterexample of Myrtos) indicates that grapes and olives were not an important part of the Early Bronze Age economy. Hamilakis also argues that we should not expect specialized wine and oil production to be important parts of the Early Bronze Age village economy because they are risky endeavors not compatible with the interests of small farmers in uncertain environments. Hamilakis completely ignores the fact that wine and oil are not the only products produced by vines and olive trees. Grapes and olives are both nutritionally valuable in themselves, a point that Hamilakis emphatically refuses to consider, and their cultivation was probably adopted partially as a buffer against failures in grain agriculture and partially just to relieve its gastronomic monotony. Olive groves in particular are quite compatible with grain agriculture, since grain can be grown beneath and between the olive trees, as is still done in south-central Sardinia.

I do think the adoption of grape and olive cultivation can help explain the formation of high levels of social complexity in the East Mediterranean as well as the comparatively low levels of social complexity that formed in the West Mediterranean. Grape vines and olive trees are both labor-intensive, immoveable land-improvements.

Both take years to become productive after villagers invest in their planting. It is not necessary for either wine or oil production to have been pursued intensively by Early Bronze Age villagers for the cultivation of grape and olive to have limited the mobility of East Mediterranean villagers; it is only necessary that villagers began to invest enough time in their grape vines and olive trees to be unwilling or unable to move away from them. The decrease in mobility that accompanied the small-scale but widespread adoption of grape and olive would have allowed the formation of social complexity through the processes discussed in Chapter 2; competitive feasts and displays among the newly emergent elite may then have encouraged the intensification of grape and olive production and the development of wine drinking culture and the popularity of perfumed oils.

Grape and olive do not appear to have been adopted in the West Mediterranean during the Early Bronze Age. There is some evidence for the use of grape and olive at Middle Bronze Age sites in Sardinia, including Sa Conca Sa Cresia, but the evidence is sparse and the species utilized are likely to be native wild species rather than cultivars. Further research is necessary to confirm this chronology, but the current state of the evidence does not suggest use of cultivated grape and olive before the Late or Final Bronze Age at the earliest, and does not indicate the adoption of wine culture until the Final Bronze Age or Early Iron Age at the earliest, and possibly only after more sustained contact with East Mediterranean travelers.

The failure to adopt grape and olive cultivation in the West Mediterranean during the Early Bronze Age may have had important implications for incipient elites. Without labor-intensive, non-moveable land improvements restricting producer mobility, elites would have been stuck using systems of motivation, reward, and group identity building to justify and enhance their position. As discussed in Chapter 3, these strategies are unstable and are prone to local failures.

Another essential question about the relationship between East and West Mediterranean comes up when considering the end of the Bronze Age. This proved a catastrophic time for all complex societies in the Mediterranean, from the palace destructions in the Levant and East Mediterranean islands to the disruptions of the Sea Peoples in Egypt to the sociopolitical collapse of Nuragic society. In my opinion, such a

widespread disruption involving groups of different levels of sociopolitical complexity is unlikely to be related to a simple breakdown in trade relations and is far more likely to have a unified cause. In this case, the probable climatic drying of the whole Mediterranean, felt first and most strongly in the East, is likely to have disrupted production and distribution networks and caused widespread dissatisfaction for both elites and producers. Eventually, efforts to combat decreased production and loss of faith in the sociopolitical system led to violence.

What is confusing in this reconstruction is why Nuragic people, feeling the effects of drying climate about a century later than their eastern counterparts, would choose to sail east as the evidence from Egypt, Crete, and Cyprus suggests they did. Sailing east would have taken them out of the frying pan and into the fire, so to speak, and in many ways traveling north to Corsica and then to the Italian mainland would have been a better response. Evidence for Nuragic-style *bronzetti* in Iron Age Etruscan contexts suggests that this route may eventually have been taken by some Sardinians, but evidence for movements to the east are found a few centuries earlier. Why was the first response of Nuragic people to flee further into environmental difficulty rather than away from it?

One possibility is that the Nuragic people had heard rumors of the falls of palaces and the sacking of eastern cities, and thought these events sounded like a good opportunities to take advantage of in their difficult circumstances. However, this possibility is rendered somewhat less likely by the fact that trade with Sardinia does not appear to have been frequent, at least judged by the ceramic imports, and any shipments that were bound for Sardinia from the East Mediterranean probably stopped when the sociopolitical systems of the East Mediterranean began to destabilize. Also, travelers coming to Sardinia from the east would have brought stories of decreasing crop yields along with stories of palace destructions, which would have worked against a perception of the East Mediterranean as providing a solution to current difficulties.

Another, more likely, possibility is that the Nuragic people who chose to leave the island looking for better prospects were not responding to recent information, but to long-perpetuated stories of the East as a land of riches to which Nuragic elites would go and return with exotic stories and foreign ceramics. These stories, especially considered in the absence of more current information about East Mediterranean affairs that probably

occurred when pan-Mediterranean trade networks broke down, may have spurred discontented Nuragic people to sail east in an attempt to locate and settle in these wealthy lands. The variety of stories about Sardinians and the types of Sardinian objects that occur in eastern contexts support the notion of disparate attempts at settlement and integration rather than a coherent effort at piracy. Sardinians appear to be fighting Ramses III in the temple reliefs of Medinet Habu, but another group of Sardinians is later recorded as serving in the pharaonic bodyguard (Dothan 1986). Sardinian ceramics found in Cretan and Cypriot contexts have been practical jars, cookwares, and serving wares, suggesting that the groups of migrating Sardinians were equipped to settle in the new lands they reached and the groups may have included women.

CONCLUSIONS

Considering the archaeological record of the Siddi Plateau and the proposed model in the wider contexts of the Sardinian Middle Bronze Age, the trajectory of the Nuragic society, and the pan-Mediterranean Bronze Age provides interesting insights into several old problems. While most of the ideas offered in this chapter are currently speculative, they derive from and are consistent with the theoretical framework developed in Part I of this dissertation. Future investigation into these new ways of thinking about Nuragic Sardinia provides an excellent opportunity to further test the proposed model.

Chapter 10: General Conclusion

I have undertaken this dissertation with several goals. The first has been to develop a widely-applicable theoretical framework for the interaction of elite strategies, political economy, resource use, and environmental change in complex societies. The second has been to apply the theory I developed to a case study in which environmental change in response to human economic strategies had the potential to be one explanatory factor in the sociopolitical trajectory of a community. The third has been to consider the implications of my theoretical framework and case study in its broader context.

To achieve my first goal, I surveyed theoretical, ethnographic, and archaeological literature on the development of complexity, trying to understand what complexity means from a specifically economic perspective (Chapter 2). I concluded that an economic definition of a complex society is one in which unequal access to resources is recognized as legitimate. I refer to the initial creation of legitimate unequal access to resources as economic alienation and take it as the starting point for a consideration of how such inequity can develop and be maintained. I identified the restricted availability of mobility as a form of resistance to economic alienation as the key factor in allowing social complexity to develop and be maintained, and I discussed the many ways in which mobility can be restricted, including through geographical circumscription, through increases in relative population density, and through the adoption of labor-intensive non-moveable land improvements and/or production techniques.

A second key point in my theoretical discussion is the observation that elites and producers in complex societies have different economic goals. While producers have little incentive to overproduce beyond their own needs and have a vested interest in preserving the productive capacity of their environment, elites must attempt to constantly increase the amount of surplus at their disposal, and concerns about the decreasing environmental productivity must necessarily be secondary to the need for more surplus.

When limited producer mobility allows elites to establish labor-intensive conservation methods, the increased production required by elites may be sustainable for long periods of time and only slowly result in soil salinization and other environmental damage. However, when high producer mobility prevents elites from establishing conservation methods, they may instead try to increase production through widespread extensification, with damaging effects on long-term productivity such as erosion and nitrogen depletion occurring more rapidly. Alternatively, elites may simply find it impossible to increase the surplus at their disposal sufficiently, resulting in a loss of power.

To complete my first goal, I develop my theoretical framework into a general model (Chapter 3). The model and archaeological correlates are intended to provide a useful starting point for investigating the interaction of elite strategies, political economy, resource use, and environmental change cross-culturally.

To achieve my second goal, I applied my theoretical framework to the development of social complexity in the Nuragic culture in the area of the Siddi Plateau, south-central Sardinia, during the Middle Bronze Age (Chapters 4-8). I chose a Mediterranean case study to test my theoretical framework because of the widely-recognized fragility of Mediterranean environments under certain agricultural and pastoral regimes, but also the the demonstrated possibility of farming Mediterranean environments sustainably under others (Butzer 2005). The potential of my theoretical framework to address how resource use may be related to the formation of social complexity and losses of social complexity in small-scale societies suggested the use of a case drawn from the less complex societies of the West Mediterranean rather than the more complex and urbanized societies of the East Mediterranean. The Nuragic culture of Bronze Age Sardinia, which included the first complex societies on the island, presented itself as an excellent source of case studies for the interaction of political economy and resource use in societies with developing complexity, and the Middle Bronze Age settlement system of the Siddi Plateau provides one of the largest known archaeological records relating to this period.

Architectural evidence and some finds from previous, mostly unpublished excavations on the Siddi Plateau indicated that social complexity developed there in the Middle Bronze Age, but acquiring the more detailed evidence for elite production and

consumption patterns, resource use, and environmental and climate change required additional archaeological fieldwork to be designed and implemented at the site. With the help and support of Mauro Perra, director of the Museo Genna Maria in Villanovaforru, Sardinia, I established Progetto Pran'e Siddi to recover the necessary archaeological data to apply my theoretical framework to the Nuragic community of the Siddi Plateau. Between April 2009-November 2011, with dott. Perra acting as the project's scientific director, I ran three excavation seasons and a season of artifact analysis and field survey. Although the project did not return as much Middle Bronze Age archaeological data as I had hoped, it provided enough information about elite practices at one of the excavated sites to indicate that the model I had produced could indeed be useful in understanding the interactions of elite strategies, economic behavior, resource use, and environmental change in a situation of developing and then decreasing complexity.

The results of my study of the Siddi Plateau indicate that mobility as a form of resistance was highly to moderately available to the producers of the Siddi Plateau settlement system due to low population densities and low levels of inter-group violence, for which there is only a small amount of strictly symbolic evidence. Beccause the Siddi Plateau community could use mobility to resist the demands of their leaders, increases in production took the form of agricultural extensification. Some limited experiments with agricultural intensification may have occurred, but the evidence for intensification is quite scarce and it is unlikely to have formed a meaningful part of the political economy.

Agricultural and pastoral production on the Siddi Plateau did focus increasingly on foods that are water-intensive to raise: wheat and pigs. There are only two small springs on the Siddi Plateau and the nearest seasonal streams are two kilometers away; over time, the additional work associated with raising wheat and pigs may have been perceived as burdensome by the producers of the community. The Mediterranean climate may also have become drier during the Middle Bronze Age, making water-intensive agriculture even more difficult. The settlement system of the Siddi Plateau was abandoned at the end of the Middle Bronze Age, and this abandonment should probably be seen as a compromise between elites seeking higher agricultural productivity and non-elites resisting higher labor demands.

The Middle Bronze Age occupation of the Siddi Plateau does not appear to have

damaged the long-term productive potential of the environment. Evidence for nitrogen depletion of soils or severe erosion has not yet been identified, despite the fact that agricultural extensification can often lead to these kinds of damage. There are several possible explanations for this phenomenon, and the available evidence cannot currently distinguish among them. However, it is worth considering that the environment in some areas of the Mediterranean may be more resilient than it is often thought to be, that 300 years of extensive agriculture may have been insufficient to cause environmental degradation in the area around the Siddi Plateau, and that producers of the Siddi Plateau community may have been able to exercise strong resistence against the demands of their leaders, limiting the amount of extensification that actually took place.

To partially meet my third goal, I briefly discussed what I see as some of the broader implications of my work in its Mediterranean context at the end of this dissertation (Chapter 9). Some of my major conclusions include the observation that Nuragic communities of the Middle Bronze Age may have been less stratified than some scholars, including myself, have previously thought. The lack of evidence for environmental degradation suggests that the leaders of the Siddi Plateau may not have been as powerful as I had assumed. They may have been subject to the strong resistence of the producing segment of their communities and may still have been bound by reciprocal obligations of kinship. If so, this would mean that the Middle Bronze Age Nuragic community of the Siddi Plateau was not truly complex by the definition employed in my model: full economic alienation had not yet taken place. Instead, the community may be better characterized by the earliest stage in my model, in which economic alienation is still developing. Understanding whether full economic alienation had indeed taken place in the Middle Bronze Age on Sardinia will require further archaeological investigations into a wider variety of sites than was possible for this dissertation; this is one area of my research I see as having great potential for inspiring future work.

The additional implications of my work that I identify in Chapter 9 also remain to be investigated and tested, and may prove more or less accurate or in need of revision, just as I have already revised some of my own understandings of the beginnings of the Nuragic culture in response to the research presented here. I consider it an indication of

the strength and clarity of the theoretical framework proposed in this dissertation that it has guided and challenged my interpretation of the archaeological record of the Siddi Plateau, rather than being a reflection of that record.

Appendix A: List of Stratigraphic Units and Harris Matrix for Sa Conca Sa Cresia Trench I

1 Topsoil

2 Erosional layer

3 Wall collapse, from period in which nuraghe was abandoned/collapsing. This probably includes several episodes of collapse that could not be distinguished while excavating. Finds from this layer include Punic/Roman pottery and an Italian coin dating to 1941.

4 Probable destruction layer on the northwest side of the internal wall indicating the final use of this part of the nuraghe. Large amounts of burned daub were found in this layer, suggesting a burned/collapsed roof.

5 Probable destruction layer on the southeast side of the internal wall indicating the final use of this part of the nuraghe. Large amounts of burned daub were found in this layer, suggesting a burned/collapsed roof.

6 Soil and stones from the area where the small internal wall (USM 3) had been taken down (this act of destruction is the negative SU - USM 4). SU 6 is probably the same as SU 5.

7 Same as SU 5

8 Compact clay occupation layer associated with the small wall (USM 3) on its west side.

9 Friable, ashy occupation layer associated with USM 3 on its east side.

10 Hearth on top of dismantled part of USM 3 and associated ash deposit. SU 9 was found on top of, around, and lower than SU 10.

11 Dark compact clay with even more burned daub in it than SU 4. This is the foundation layer of USM on its west side.

12 A mound of compact ash on top of the foundation layer of USM 3 on its east side

(SU 16).

13 A very thin friable yellow layer under SU 15. Probably equivalent to SU 18, 21, 23, forming part of the same industrial deposit.

14 Originally thought the be a negative SU, but later simply discarded as interpretation became clearer.

15 A compact living surface under the west foundation layer (SU 11) of USM 3. This layer, which was partially destroyed before the foundation layer of USM 3 was laid down, exists only on west side of USM 3. Was not excavated.

16 The foundation layer of USM 3 on its east side.

17 A crumbly, super-heated ash layer on the east side of USM 3 that is probably the same as SU 18, 21, 23.

18 White, highly friable layer of super-heated ash under SU 13. The layer contained fire-cracked rock and a mineral accretion that looked like sulfur on the rocks and ceramics in the layer. Strongly suggests industrial activity, possible metal working.

19 Highly bioturbated area (roots, rodent burrows, ants) near east wall of naviform room (USM 2) at roughly the same elevation as SU 17 and SU 20. Layers that were visible in the rest of the trench could not be distinguished here. Finds from this SU should be considered with heavy bioturbation mind.

20 A lighter sediment under SU 17

21 Arbitrary SU under SU 18, created because SU 18 was getting quite deep. No visible stratigraphic change from SU 18.

22 Hearth and associated ash deposit under SU 17, 19 and on top of SU 26. Although it is partially below SU 19, it shows no major bioturbation and is clearly visible, including immediately next to USM 2.

23 Darker, redder ash under SU 21. Probably part of the same deposit and equivalent to SU 18, 21.

24 Degraded clay living surface or occupation layer under SU 20.

25 Finer dark brown sediment under the industrial deposit in the west side of the trench (SU 13, 18, 21, 23). SU 25 is the last occupation before the industrial phase begins and is probably equivalent to SU 20 on the east side of USM 3.

26 Dark, burned clay living surface east of USM 3 with in-situ artifacts and ceramics

associated with hearth/ash deposit SU 22. Probably the same as SU 28 on the west side of USM 3.

27 Highly bioturbated layer in the southern part of the east side of the trench where USM 2 and USM 3 form a tight corner.

28 Dark, burned clay living surface west of USM 3 with in-situ artifacts and ceramics. The top part of SU 28 is probably the same as SU 26 on the east side of USM 3; however, living surfaces are impossible to distinguish without the aid of hearths and surface pottery, so SU 28 is probably also equivalent to SU 30.

29 A clay layer below SU 28 that is slightly lighter gray in color.

30 A clay floor below SU 26.

31 An arbitrary new SU under SU 29. No visible stratigraphic change from SU 29.

32 Ash deposit below SU 30 and on top of (associated with) SU 34.

33 A highly bioturbated SU directly below SU 27.

34 A clay floor below SU 30, 32. Ash deposit SU 32 is associated with this floor.

35 An arbitrary new SU under SU 31. No visible stratigraphic change from SU 31.

36 A clay floor below SU 34.

37 An arbitrary new SU under SU 35. No visible stratigraphic change from SU 35.

38 A clay floor below SU 36.

39 A real stratigraphic change to a darker, redder clay under SU 37.

40 Ash deposit under SU 38 and on top of/associated with SU 41.

41 Clay floor with baked hearth surface below SU 38, 40 and associated with ash deposit SU 40.

42 Clay foundation layer of original corridor of nuraghe. Likely to be slightly older than SU 47, foundation of naviform room, because the corridor was built first, then dismantled and turned into the naviform room.

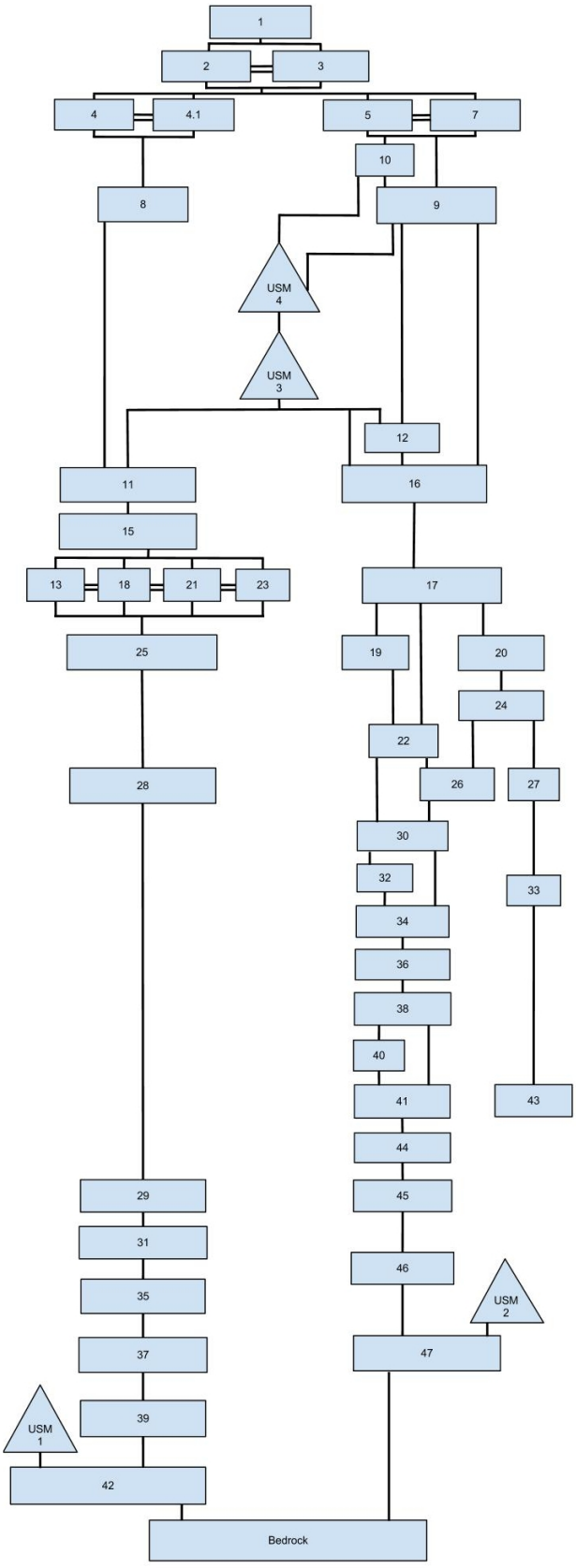
43 Highly bioturbated SU directly below SU 33. Left unexcavated.

44 Clay floor with baked hearth surface below SU 41.

45 Clay floor with baked hearth surface below SU 44. May be equivalent to SU 29 or 31 on the west side of USM 3 because of presence of second hearth surface extending under USM 3 that may be related to the hard-baked clay areas found extending under USM 3 in SU 29.

46 Clay floor with degraded hearth surface below SU 45.

47 Highly cultural fill layer with distinct baked hearth surface evening out the bedrock for the construction of the naviform room. Represents the creation and first occupation of the naviform room.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USM 1
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Bedrock

Works Cited

Abahussain, Asma Ali, Anwar Sh. Abdu, Waleed K. Al-Zubari, Nabil Alaa El-Deen, and Mahmmod Abdul-Raheem
2002 Desertification in the Arab Region: Analysis of Current Status and Trends. Journal of Arid Environments 51(4): 521–545.

Adams, Robert McC.
1966 The Evolution of Urban Soceity. Chicago: Aldine.

Ames, Kenneth
1994 The Northwest Coast: Complex Hunter-Gatherers, Ecology, and Social Evolution. Annual Review of Anthropology 23: 209–229.

2008 The Archaeology of Rank. *In* Handbook of Archaeological Theories. R. Alexander Bentley, Herbert D. G. Maschner, and Christopher Chippindale, eds. Pp. 487–513. Lanham, Maryland: AltaMira.

Van Andel, Tjeerd H., and Curtis Runnels
1988 An Essay on the "emergence of Civilization" in the Aegean World. Antiquity 62: 234–247.

Anderson, David G.
1994 The Savannah River Chiefdoms: Political Change in the Late Prehistoric Southeast. Tuscaloosa: University of Alabama Press.
1996 Fluctuations Between Simple and Complex Chiefdoms: Cycling in the Late Prehistoric Southeast. *In* Political Structure and Change in the Prehistoric Southeastern United States. J. F. Scarry, ed. Pp. 231–252. Gainesville: University Press of Florida.

Appadurai, Arjun, ed.
1986 The Social Life of Things. Comodities in Cultural Perspective. Cambridge: Cambridge University Press.

Ariztegui, D., C. Chondrogianni, A. Lami, P. Guilizzoni, and E. Lafargue
2001 Lacustrine Organic Matter and the Holocene Paleoenvironmental Record of Lake Albano (central Italy). Journal of Paleolimnology 26: 283–292.

Arnold, Jeanne E.
1996a The Archaeology of Complex Hunter-Gatherers. Journal of Archaeological Method and Theory 3: 77–126.
1996b Organizational Transformations: Power and Labor Among Complex Hunter-Gatherers and Other Intermediate Societies. *In* Emergent Complexity. The Evolution of Intermediate Societies. Jeanne E. Arnold, ed. Pp. 59–73. Archaeological Series, 9. Ann Arbor: International Monographs in Prehistory.

Arroyo-García, R., L. Ruiz-García, L. Bolling, et al.
2006 Multiple Origins of Cultivated Grapevine (Vitis Vinifera L. Ssp. Sativa) Based on Chloroplast DNA Polymorphisms. Molecular Ecology 15: 3707–3714.

Aru, Angelo, Paolo Baldaccini, Giuseppe Delogu, et al.
1990 Carta dei Suoli della Sardegna. Florence: S.EL.CA.

Average Weather in Alghero, Sardinia
2010 World Weather and Climate Information. http://www.weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Alghero,Sardinia, accessed May 14, 2012.

Average Weather in Cagliari, Sardinia
2010 World Weather and Climate Information. http://www.weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,Cagliari,Sardinia, accessed May 14, 2012.

Balmuth, Miriam S.
1992 Archaeology in Sardinia. American Journal of Archaeology 96(4): 663–697.

Beck, Robin A.
2003 Consolidation and Hierarchy: Chiefdom Variability in the Mississippian Southeast. American Antiquity 68(4): 641–661.

2006 Persuasive Politics and Domination at Cahokia and Moundville. *In* Leadership and Polity in Mississippian Society. Brian Butler and Paul Welch, eds. Pp. 19–42. Carbondale: Southern Illinois University.

Becker, Marshall Joseph
1984 Sardinian Stones Moulds: An Indirect Means of Evaluating Bronze Age Metallurgical Technology. *In* Studies in Sardinian Archaeology. Miriam S. Balmuth and Robert J. Rowland Jr., eds. Pp. 163–208. Ann Arbor: University of Michigan Press.

Bender, B.
1978 Gatherer-hunter to Farmer: a Social Perspective. World Archaeology 10(2): 204–221.

1985 Emergent Tribal Formations in the American Midcontinent. American Antiquity

50(1): 52–62.

Bernardini, Paolo
2010 Le torri, i metalli, il mare. Storie antiche di un'isola mediterranea. Sassari: Carlo Delfino Editore.

Besnard, Guillaume, and André Bervillé
2000 Multiple Origins for Mediterranean Olive (Olea Europaea L. Ssp. Europaea) Based Upon Mitochondrial DNA Polymorphisms. Comptes Rendus de l'Académie Des Sciences - Series IIIA - Science de La Vie 323: 173–181.

Biagi, Paolo
2003 A Review of the Late Mesolithic in Italy and Its Implications for the Neolithic Transition. *In* The Widening Harvest. The Neolithic Transition in Europe: Looking Back, Looking Forward. Albert J. Ammerman and Paolo Biagi, eds. Pp. 133–155. Colloquia and Conference Papers, 6. Boston: Archaeological Institute of America.

Blake, Emma
1999 Identity-Mapping in the Sardinian Bronze Age. European Journal of Archaeology 2(1): 35–55.
2001 Constructing a Nuragic Locale: The Spatial Relationship Between Tombs and Towers in Bronze Age Sardinia. American Journal of Archaeology 105(2): 145–161.
2008 The Mycenaeans in Italy: a Minimalist Position. Papers of the British School at Rome 76: 1–34.

Blitz, John H.
1999 Mississippian Chiefdoms and the Fission-Fusion Process. American Antiquity 64(4): 577–592.

Boas, Franz, and Helen Codere
1966 Kwakiutl Ethnography. Chicago and London: The University of Chicago Press.

Boehm, Christopher
1999 Hierarchy in the Forest: The Evolution of Egalitarian Behavior. Cambridge, Massachusetts: Harvard University Press.

Boserup, Esther
1965 The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure. Chicago: Aldine Publishing Company.

Bradley, Richard
2002 The Past in Prehistoric Societies. London: Routledge.

Broodbank, Cyprian
2000 An Island Archaeology of the Early Cyclades. Cambridge: Cambridge University Press.

Brumfiel, Elizabeth M.
1992 Distinguished Lecture in Archeology: Breaking and Entering the Ecosystem - Gender, Class, and Faction Steal the Show. American Anthropologist 94(3): 551–567.

Brumfiel, Elizabeth M., and Timothy K. Earle
1987 Specialization, Exchange, and Complex Societies: An Introduction. *In* Specialization, Exchange, and Complex Societies. Elizabeth M. Brumfiel and Earle, eds. Pp. 1–9. Cambridge: Cambridge University Press.

Büntgen, Ulf, Willy Tegel, Kurt Nicolussi, et al.
2011 2500 Years of European Climate Variability and Human Susceptibility. Science 331: 578–582.

Butzer, Karl W.
2005 Environmental History in the Mediterranean World: Cross-disciplinary Investigation of Cause-and-effect for Degradation and Soil Erosion. Journal of Archaeological Science 32: 1773–1800.

Campus, Franco, Valentina Leonelli, and Fulvia Lo Schiavo
2010 La transizione culturale dall'età del bronzo all'età del ferro nella Sardegna nuragica in relazione con l'Italia tirrenica. Bolletino di Archeologia on line Volume speciale F: 62–76.

De Caraffa, V. Bronzini, J. Maury, C. Gambotti, et al.
2002 Mitochondrial DNA Variation and RAPD Mark Oleasters, Olive and Feral Olive from Western and Eastern Mediterranean. Theorectical and Applied Genetics 104: 1209–1216.

Carneiro, Robert
1970 A Theory of the Origin of the State. Science 169(3947): 733–738.
1978 Political Expansion as an Expression of the Principle of Competitive Exclusion. *In* Origins of the State: The Anthropology of Political Evolution. Ronald Cohen and Elman R. Service, eds. Pp. 205–223. Philadelphia: Institute for the Study of Human Issues.
1981 The Chiefdom: Precursor of the State. *In* The Transition to Statehood in the New World. Grant D. Jones and Robert R. Kautz, eds. Pp. 37–79. Cambridge: Cambridge University Press.

Cashdan, E.
1980 Egalitarianism Among Hunters and Gatherers. American Anthropologist 82: 116–120.

Castaldi, E.
1968 Nuove osservazioni sulle "tombe di giganti." Bullettino di Paletnologia Italiana 77: 7–91.

1969 Tombe di giganti nel Sassarese. Origini 3: 119–274.

Chagnon, Napoleon
1968 Yanomamo, the Fierce People. Case Studies in Cultural Anthropology. New York: Holt, Rinehart & Winston.

Cherry, John F.
1992 Palaeolithic Sardinians? Some Questions of Evidence and Method. *In* Sardinia in the Mediterranean: A Footprint in the Sea. Robert H. Tykot and Tamsey K. Andrews, eds. Pp. 28–48. Oxford: Sheffield Academic Press.

Childe, V. Gordon
1952 What Happened in History? Harmondsworth: Penguin.
1974 The Urban Revolution. *In* The Rise and Fall of Civilizations. J. Sabloff and C. C. Lamberg-Karlovsky, eds. Pp. 6–14. Menlo Park, California: Cummings.

Cohen, Mark N.
1977 The Food Crisis in Prehistory. Overpopulation and the Origins of Agriculture. New Haven and London: Yale University Press.

Cowgill, George L.
1975 Population Pressure as a Non-Explanation. Memoirs of the Society for American Archaeology 30(Population Studies in Archaeology and Biological Anthropology: A Symposium (1975)): 127–131.

D'Altroy, Terence N., and Timothy K. Earle
1985 Staple Finance, Wealth Finance and Storage in the Inka Political Economy. Current Anthropology 26: 187–206.

deMenocal, Peter B.
2001 Cultural Responses to Climate Change During the Late Holocene. Science 292(5517): 667–673.

Depalmas, Anna
2009a Il Bronzo medio della Sardegna. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali Pp. 123–130. Florence: Istituto Italiano di Preistoria e Protostoria.
2009b Il Bronze recente della Sardegna. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 131–140. Florence: Istituto Italiano di Preistoria e Protostoria.
2009c Il Bronzo finale della Sardegna. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 141–154. Florence: Istituto Italiano di Preistoria e Protostoria.

Dietler, Michael
1990 Driven by Drink: The Role of Drinking in the Political Economy and the Case of Early Iron Age France. Journal of Anthropological Archaeology 9: 352–406.

Dietler, Michael, and Brian Hayden, eds.
2001 Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power. Washington D.C.: Smithsonian Institution Press.

Dighton, Anne, and Andrew Stephen Fairbairn
2012 Interim Report on the Archaeobotanical Analysis. Progetto Pran'e Siddi - Sa Conca Sa Cresia. Unpublished. Brisbane: University of Queensland.

Van Dommelen, Peter
1998 On Colonial Grounds. A Comparative Study of Colonialism and Rural Settlement in First Millennium BC West Central Sardinia. Leiden: Faculty of Archaeology, University of Leiden.

Dormoy, I., O. Peyron, N. Combourieu Nebout, et al.
2009 Terrestrial Climate Variability and Seasonality Changes in the Mediterranean Region Between 15 000 and 4000 Years BP Deduced from Marine Pollen Records. Climate of the Past 4: 615–632.

Dothan, Moshe
1986 Šardina at Akko? *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 105–115. Ann Arbor: University of Michigan Press.

Durrenberger, E. Paul, and Nicola Tannenbaum
1992 Household Economy, Political Economy, and Ideology: Peasants and the State in Southeast Asia. American Anthropologist 94(1): 74–89.

Van Dyke, Ruth M., and Susan E. Alcock, eds.
2003 Archaeologies of Memory. Malden, Massachusetts: Blackwell.

Dyson, Stephen L., and Robert J. Rowland
1992 Survey and Settlement Reconstruction in West-Central Sardinia. American Journal of Archaeology 96(2): 203–224.
2007 Shepherds, Sailors, and Conquerors. Archaeology and History in Sardinia from the Stone Age to the Middle Ages. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Earle, Timothy K.
1978 Economic and Social Organization of a Complex Chiefdom: The Halele'a District, Haua'i, Hawai'i. Anthropological Papers, 63. Ann Arbor: Museum of Anthropology, University of Michigan.

1982 The Ecology and Politics of Primitive Valuables. *In* Culture and Ecology: Eclectic Perspectives. J. Kennedy and R. Edgerton, eds. Pp. 65–83. Special Publication, 15. Washington D.C.: American Anthropological Association.
1997 How Chiefs Come to Power. Palo Alto: Stanford University Press.
2002 Bronze Age Economics. Boulder, Colorado: Westview Press.

Ekholm, K.
1972 Power and Prestige: The Rise and Fall of the Kongo Kingdom. Uppsala: Skriv service AB.

Finné, Martin, Karin Holmgren, Hanna S. Sundqvist, Erika Weiberg, and Michael Lindblom
2011 Climate in the Eastern Mediterranean, and Adjacent Regions, During the Past 6000 Years: A Review. Journal of Archaeological Science 38: 3153–3173.

Flanagan, James, and Steve Rayner
1988 Introduction. *In* Rules, Decisions, and Inequality in Egalitarian Societies Pp. 1–19. Aldershot, England: Gower Publishing Company.

Flannery, Kent V.
1969 Origins and Ecological Effects of Early Domestication in Iran and the Near East. *In* The Domestication and Exploitation of Plants and Animals. Peter J. Ucko and G. W. Dimbleby, eds. Pp. 73–100. London: Duckworth.
2002 The Origins of the Village Revisited: From Nuclear to Extended Households. American Antiquity 67: 417–433.

Flannery, Kent V., and Joyce Marcus
2003 The Origin of War: New c14 Dates from Ancient Mexico. Proceedings of the National Academy of Sciences 100(20): 11801–11805.

Frankenstein, S., and M. J. Rowlands
1978 The Internal Structure and Regional Context of Early Iron Age Society in South-western Germany. University of London Institute of Archaeology Bulletin 15: 73–112.

Freuchen, Peter
1961 Book of the Eskimos. Cleveland: World Publishing.

Fried, Morton H.
1967 The Evolution of Political Soceity. An Essay in Political Anthropology. New York: Random House.

Gavrilets, Sergey, David G. Anderson, and Peter Turchin
2010 Cycling in the Complexity of Early Societies. Cliodynamics: The Journal of Theoretical and Mathematical History 1(1): 58–80.

Gerlach, Luther P., and Ursula M. Gerlach
1988 Egalitarianism, Collectivism, and Individualism: The Digo of Kenya. *In* Rules, Decisions, and Inequality in Egalitarian Societies Pp. 113–144. Aldershot, England: Gower Publishing Company.

Giddens, Anthony
1979 Central Problems in Social Theory. London: Macmillan.

Gilman, Antonio
1976 Bronze Age Dynamics in Southeast Spain. Dialectical Anthropology 1(4): 307–319.
1981 The Development of Social Stratification in Bronze Age Europe. Current Anthropology 22(1): 1–8.

Gosden, Chris, and Yvonne Marshall
1999 The Cultural Biography of Objects. World Archaeology 31(2): 169–178.

Gould, Richard A.
1982 To Have and Have Not: The Ecology of Sharing Among Hunter-Gatherers. *In* Resources Managers: North American and Australian Hunter-Gatherers. Nancy M. Williams and Eugene S. Hunn, eds. Pp. 69–91. American Association for the Advancement of Science Selected Symposia Series. Canberra: Australian Institute of Aboriginal Studies.

Gramsci, Antonio
1972 Selections from the Prison Notebooks of Antonio Gramsci. Quintin Hoare and Geoffrey Nowell Smith, eds. New York: International Publishers.

Green, Roger, ed.
1980 Makaha Before 1880 A.D. Makaha Valley Historical Project Summary Report, 5. Honolulu: Department of Anthropology, Bernice P. Bishop Museum.

Hadden, Sally E.
1999 Colonial and Revolutionary Era Slave Patrols of Virginia. *In* Lethal Imagination: Violence and Brutality in American History. Michael A. Bellesiles, ed. Pp. 69–85. New York: New York University Press.

Håkansson, N. Thomas
2010 History and the Problem of Synchronic Models. Current Anthropology 51(1): 105–107.

Halstead, Paul
1990 Waste Not, Want Not: Traditional Responses to Crop Failure in Greece. Rural History 1(2): 147–164.

Hamilakis, Yannis
1999 Food Technologies/Technologies of the Body: The Social Context of Wine and Oil Production and Consumption in Bronze Age Crete. World Archaeology 31(1): 38–54.

Haug, Gerald H., Detlef Günther, Larry C. Peterson, et al.
2003 Climate and the Collapse of Maya Civilization. Science 299(5613): 1731–1735.

Hayden, Brian
1996 Feasting in Prehistoric and Traditional Societies. *In* Food and the Status Quest: An Interdisciplinary Perspective. Polly Wiessner and Wulf Schiefenhövel, eds. Pp. 127–147. Providence: Berghahn Books.
1998 Practical and Prestige Technologies: The Evolution of Material Systems. Journal of Archaeological Method and Theory 5: 1–55.
2001 Richman, Poorman, Beggarman, Chief: The Dynamics of Social Inequality. *In* Archaeology at the Millennium: A Sourcebook. Gary M. Feinman and T. Douglas Price, eds. Pp. 231–272. New York: Kluwer Academic/Plenum.

Helms, Mary W.
1988 Ulysses's Sail. An Ethnographic Odyssey of Power, Knowledge, and Geographical Distance. Princeton: Princeton University Press.
1993 Craft and the Kingly Ideal. Art, Trade, and Power. Austin: University of Texas Press.

Henrich, Joseph
2001 Cultural Transmission and the Diffusion of Innovations: Adoption Dynamics Indicate That Biased Cultural Transmission Is the Predominate Force in Behavioral Change. American Anthropologist 103(4). New Series: 992–1013.

Holm, Bill
1983 Smoky-Top: The Art and Times of Willie Seaweed. Vancouver: Douglas and McIntyre.

Hoskins, Janet
1993 The Play of Time: Kodi Perspectives on Calendars, History, and Exchange. Berkeley: University of California Press.
1998 Biographical Objects. How Things Tell the Stories of People's Lives. New York: Routledge.

Issar, Arie S.
2007 Climatic Changes in the Eastern Mediterranean from the Last Glacial Maximum to the Late Holocene. *In* The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement. Valentina Yanko-Hombach, Allan S. Gilbert, Nicolae Panin, and Pvel M. Dolukhanov, eds. Pp. 809–818. Dordrecht: Springer.

Jalut, Guy, Jean Jacques Dedoubat, Michel Fontugne, and Thierry Otto
2009 Holocene circum-Mediterranean Vegetation Changes: Climate Forcing and

Human Impact. Quaternary International 200: 4–18.

Jalut, Guy, Augustin Esteban Amat, Louis Bonnet, Thierry Gauquelin, and Michel Fontugne
2000 Holocene Climatic Changes in the Western Mediterranean, from South-east France to South-east Spain. Palaeogeography, Palaeoclimatology, Palaeoecology 160: 255–290.

Jones, Arwyn, Luca Montanarella, and Robert Jones, eds.
2005 Soil Atlas of Europe. Luxembourg: Office for Official Publications of the European Communities.

Junker, Laura L.
1999 Raiding, Trading, and Feasting: The Political Economy of Philippine Chiefdoms. Honolulu: University of Hawai'i Press.

Keeley, Lawrence
1996 War Before Civilization. New York: Oxford University Press.

Kirch, Patrick
1977 Valley Agricultural Systems in Prehistoric Hawaii: An Archaeological Consideration. Asian Perspectives 20: 246–280.

Lami, A., P. Guilizzoni, D.B. Ryves, et al.
1997 A Late Glacial and Holocene Record of Biological and Environmental Changes from the Crater Lake Albano, Central ITtaly: An Iinterdisciplinary European Project (PALICLAS). Water, Air and Soil Pollution 99: 601–613.

Leach, Edmund R.
1970 Political Systems of Highland Burma. A Study of Kachin Social Structure. London School of Economics Monographs on Social Anthropology, 44. London: The Athlone Press.

LeBlanc, Steven A.
1999 Prehistoric Warfare in the American Southwest. Salt Lake City: University of Utah Press.

Lee, R. B.
1969 !Kung Bushman Subsistence: An Input-output Analysis. *In* Environment and Cultural Behavior: Ecological Studies in Cultural Anthropology. A. P. Vayda, ed. Pp. 47–79. Austin: University of Texas Press.
1979 The !Kung San: Men, Women, and Work in a Foraging Society. Cambridge: Cambridge University Press.

Lewthwaite, James
1986 Nuragic Foundations: An Alternate Model of Development in Sardinian

Prehistory ca. 2500-1500 B.C. *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 19–37. Ann Arbor: University of Michigan Press.

Lilliu, Giovanni
1941 Siddi. <<Su Pranu>> Di Siddi e i Suoi Monumenti Preistorici. Notizie Degli Scavi: 130–163.
1982 La Civiltá Nuragica. Sassari: Carlo Delfino Editore.
1988 La civiltà dei Sardi: dal Paleolitico all'età dei nuraghi. Third. Turin: Nuova ERI.
2002 La Civiltà Preistorica e Nuragica in Sardegna, vol.15 (3). Atti della Accademia Nazionale dei Lincei, Memorie, 9. Rome: Accamedia Nazionale dei Lincei.

López, Pilar, José Antonio López Sáez, and Rosario Macías
2005 Estudio de la paleovegetación de algunos yacimientos de la Edad del Bronce en el SE de Cerdeña. *In* Territorio Nurágico y Paisaje Antiguo: La Meseta de Pranemuru (Cerdeña) en la Edad del Bronce. Marisa Ruiz-Gálvez, ed. Pp. 91–105. Anejos de Complutum, 10. Madrid: Universidad Complutense de Madrid.

Lugliè, Carlo
2009a Il Mesolitico. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 31–36. Florence: Istituto Italiano di Preistoria e Protostoria.
2009b Il Neolitico Antico. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 37–47. Florence: Istituto Italiano di Preistoria e Protostoria.

Magny, Michel, Jacques-Louis de Beaulieu, Ruth Drescher-Schneider, et al.
2007 Holocene Climate Changes in the Central Mediterranean as Recorded by Lake-level Fluctuations at Lake Accesa (Tuscany, Italy). Quaternary Science Reviews 26: 1736–1758.

Magny, Michel, Boris Vannière, Camilla Calo, et al.
2011 Holocene Hydrological Changes in South-western Mediterranean as Recorded by Lake-level fluctuations at Lago Preola, a Coastal Lake in Southern Sicily, Italy. Quaternary Science Reviews 30(19-20): 2459–2475.

Malinowski, Bronislaw
1932 Argonauts of the Western Pacific. An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea. Second Edition. New York: Dutton.

Manca Demurtas, Lucia, and Sebastiano Demurtas
1992 Tipologie Nuragiche: I Protonuraghi con Corridoio Passante. *In* Sardinia in the Mediterranean: A Footprint in the Sea. Robert H. Tykot and Tamsey K. Andrews, eds. Pp. 176–184. Oxford: Sheffield Academic Press.

Mars, Gerald
1988 Hidden Hierarchies in Israeli Kibbutzim. *In* Rules, Decisions, and Inequality in Egalitarian Societies Pp. 98–112. Aldershot, England: Gower Publishing Company.

Marsh, Anke
2012 Phytolith Analysis at Sa Conca Sa Cresia, Sardinia: Preliminary Analysis. Unpublished. London: Institute of Archaeology, UCL.

Martini, Fabio
2009 Il Paleolitico in Sardegna: evidenze, problemi e ipotesi a trent'anni dalla scoperta. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 17–27. Florence: Istituto Italiano di Preistoria e Protostoria.

Massoli-Novelli, Raniero
1986 The Geology, Environment, and Natural Resources of Sardinia. *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 3–7. Ann Arbor: University of Michigan Press.

Melis, Maria Grazia
2009 L'Eneolitico antico, medio ed evoluto in Sardegna: dalla fine dell'Ozieri all'Abealzu. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 81–95. Florence: Istituto Italiano di Preistoria e Protostoria.

Moravetti, Alberto
2009 La cultura di Monte Claro e il Vaso Campaniforme. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali Pp. 97–106. Florence: Istituto Italiano di Preistoria e Protostoria.

Naimo, Debora, Paola Adamo, Massimiliano Imperato, and Damiano Stanzione
2005 Mineralogy and Geochemistry of a Marine Sequence, Gulf of Salerno, Italy. Quaternary International 140-141: 53–63.

Nash, Manning
1966 Primitive and Peasant Economic Systems. San Francisco: Chandler.

Nash, Stephen
2011 Archaeology and Sustainability: Improbable Bedfellows. Anthropology News 52(7): 34.

Nichols, D. L., C. D. Frederick, L. Morett Alatorre, and F. Sánchez Martínez

2006 Water Management and Political Economy in Formative Period Central Mexico. *In* Ritual Water Management. Lisa Lucero and Barbara Fash, eds. Pp. 51–66. Tucson: University of Arizona Press.

O'Brien, Michael J., and Stephen J. Shennan, eds.
2010 Innovations in Cultural Systems. Contributions from Evolutionary Anthropology. Vienna Series in Theoretical Biology. Cambridge, Massachusetts: MIT Press.

Pearson, Harry W.
1957 The Economy Has No Surplus: Critique of a Theory of Development. *In* Trade and Market in the Early Empires. Economies in History and Theory. Karl Polanyi, Conrad M. Arensberg, and Harry W. Pearson, eds. Pp. 320–341. New York: Free Press.

Peebles, Christopher S., and Susan M. Kus
1977 Some Archaeological Correlates of Ranked Societies. American Antiquity 42(3): 421–448.

Perra, Mauro
2009 Osservazioni sull'evoluzione sociale e politica in età nuragica. Rivista di Scienze Preistoriche 59: 355–368.

Peterson, Nicolas
1993 Demand Sharing: Reciprocity and the Pressure for Generosity Among Foragers. American Anthropologist 95(4). New Series: 860–874.

Peyron, Odile, Simon Goring, Isabelle Dormoy, et al.
2011 Holocene Seasonality Changes in the Central Mediterranean Region Reconstructed from the Pollen Sequences of Lake Accesa (Italy) and Tenaghi Philippon (Greece). The Holocene 21(1): 131–146.

Phillips, Patricia
1986 Sardinian Obsidian and Neolithic Exchange in the West Mediterranean. *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 203–209. Ann Arbor: University of Michigan Press.

Pittau, Paola, Carlo Luglie, Carla Buosi, Ignazio Sanna, and Myriam Del Rio
2012 Palynological Interpretation of the Early Neolithic Coastal Open-air Site at Sa Punta (central-western Sardinia, Italy). Journal of Archaeological Science 39: 1260–1270.

Porcu, A. M., P. Pittau, C. Cervato, and R. Melis
2007 Holocene Multiproxy Paleoclimate Record from Lagoonal Organic Shales of the Gulf of Cagliari, South Sardinia, Italy. Geophysical Research Abstracts 9(11511): 1–2.

Potter, James M.
2000 Pots, Parties, and Politics: Communal Feasting in the American Southwest. American Antiquity 65(3): 471–492.

Prentiss, William C., and Ian Kuijt, eds.
2004 Complex Hunter-gatherers : Evolution and Organization of Prehistoric Communities on the Plateau of Northwestern North America. The Anthropology of Pacific North America. Salt Lake City: University of Utah Press.

Price, T. Douglas, and Gary M. Feinman, eds.
2010 Pathways to Power: New Perspectives on the Emergence of Social Inequality. Fundamental Issues in Archaeology. New York: Springer.

Puccini, Antonio, Stefano Cuccuru, Daniele Sechi, et al.
2010 Natural radioactivity in Sardinian granite dimension stones. *In* Atti del 85° Congresso Nazionale della Società Geologica Italiana. E. Bonaccorsi, B. Carmina, D. Marchetti, and M. Pappalardo, eds. Pp. 552–553.

Rayner, Steve
1988 The Rules That Keep Us Equal: Complexity and Costs of Egalitarian Organization. *In* Rules, Decisions, and Inequality in Egalitarian Societies Pp. 20–42. Aldershot, England: Gower Publishing Company.

Redding, Richard W.
2010 Status and Diet at the Workers' Town, Giza, Egypt. *In* Anthropological Approaches to Zoorarchaeology: Complexity, Colonialism and Animal Transformations. D. Campana, P. Crabtree, S. D. deFrance, J. Lev-Tov, and A. Choyke, eds. Pp. 65–75. Cambridge: Oxbow Books.

Roberts, N., D. Brayshaw, C. Kuzucuoğlu, R. Perez, and L. Sadori
2011 The mid-Holocene Climatic Transition in the Mediterranean: Causes and Consequences. The Holocene 21(3): 3–13.

Roberts, N., M.D. Jones, A. Benkaddour, et al.
2008 Stable Isotope Records of Late Quaternary Climate and Hydrology from Mediterranean Lakes: The ISOMED Synthesis. Quaternary Science Reviews 27: 2426–2441.

Rossignol-Strick, Martine, and Nadine Planchais
1989 Climate Patterns Revealed by Pollen and Oxygen Isotope Records of a Tyrrhenian Sea Core. Nature 342: 413–416.

Rouis-Zargouni, Imene, Jean-Louis Turon, Laurent Londeix, et al.
2010 Environmental and Climatic Changes in the Central Mediterranean Sea (Siculo–Tunisian Strait) During the Last 30 Ka Based on Dinoflagellate Cyst and Planktonic Foraminifera Assemblages. Palaeogeography, Palaeoclimatology, Palaeoecology 285: 17–29.

Rowland, Robert J.
1988 The Archaeology of Roman Sardinia: a Selected Typological Inventory. *In* Rise and Decline of the Roman World, Part II: Principate Pp. 740–875. Berlin: Walter de Gruyter.
2001 The Periphery in the Center: Sardinia in the Ancient and Medieval Worlds. BAR International Series, 970. Oxford: Archaeopress.

Ruiz-Gálvez, M., ed.
2005 Territorio nurágico y paisaje antiguo. La meseta de Pranemuru (Cerdeña) en la Edad del Bronce. Madrid: Universidad Complutense de Madrid.

Russell, Anthony
2010 Foreign Materials, Islander Mobility and Elite Identity in Late Bronze Age Sardinia. *In* Material Connections in the Ancient Mediterranean: Mobility, Materiality and Identity. Peter Van Dommelen and A. Bernard Knapp, eds. Pp. 106–126. New York: Routledge.

Sadori, L., G. Tanda, and M. Follieri
1989 Macrofossili vegetali provenienti dalla necropoli neolitica a domus de janas di Molia presso Illorai (Sassari). Giornale botanico italiano 123 suppl. 1: 68.

Sadori, Laura, S. Jahns, and O. Peyron
2011 Mid-Holocene Vegetation History of the Central Mediterranean. The Holocene 21(1): 117–129.

Sadori, Laura, and Biancamaria Narcisi
2001 The Postglacial Record of Environmental History from Lago Di Pergusa, Sicily. The Holocene 11(6): 655–670.

Sahlins, Marshall
1963 Poor Man, Rich Man, Big-Man, Chief: Political Types in Melanesia and Polynesia. Comparative Studies in Society and History 5(3): 285–303.
1972 Stone Age Economics. Chicago: Aldine-Atheron.

Santoni, Vincenzo
2009 La cultura del Bronzo Antico I-II in Sardegna. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 113–121. Florence: Istituto Italiano di Preistoria e Protostoria.

Sawyer, R. Keith
2006 Explaining Creativity. The Science of Human Innovation. Oxford: Oxford University Press.

Lo Schiavo, Fulvia
1986 Sardinian Metallurgy: The Archaeological Background. *In* Studies in Sardinian

Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 231–250. Ann Arbor: University of Michigan Press.

Schüle, Wilhelm
1993 Mammals, Vegetation and the Initial Human Settlement of the Mediterranean Islands: A Palaeoecological Approach. Journal of Biogeography 20(4): 399–411.

Seip, Lisa P.
1999 Transformations of Meaning: The Life History of a Nuxalk Mask. World Archaeology 31(2): 272–287.

Skeates, Robin
2003 Radiocarbon Dating and Interpretations of the Mesolithic-Neolithic Transition in Italy. *In* The Widening Harvest. The Neolithic Transition in Europe: Looking Back, Looking Forward. Albert J. Ammerman and Paolo Biagi, eds. Pp. 157–187. Colloquia and Conference Papers, 6. Boston: Archaeological Institute of America.

Smith, Joyotee, Anthony D. Barau, Abraham Goldman, and James H. Mareck
1994 The Role of Technology in Agricultural Intensification: The Evolution of Maize Production in the Northern Guinea Savanna of Nigeria. Economic Development and Cultural Change 42(3): 537–554.

Spielmann, Katherine A.
1998 Ritual Craft Specailists in Middle Range Soceities. Archeological Papers of the American Anthropological Association 8(1): 153–159.
2002 Feasting, Craft Specialization, and the Ritual Mode of Production in Small-Scale Societies. American Anthropologist 104(1). New Series: 195–207.

Steponaitis, Vincas P.
1978 Location Theory and Complex Chiefdoms: A Mississippian Example. *In* Mississippian Settlement Patterns. Bruce D. Smith, ed. Pp. 417–454. Studies in Archaeology. New York: Academic Press.
1981 Settlement Hierarchies and Political Complexity in Nonmarket Societies: The Formative Period of the Valley of Mexico. American Anthropologist 83(2): 320–363.

Strathern, Andrew
1971 The Rope of Moka: Big-men and Ceremonial Exchange in Mount Hagen, New Guinea. Cambridge Studies in Social Anthropology, 4. Cambridge: Cambridge University Press.

Tachibana, Towa, Trung M. Nguyen, and Keijiro Otsuka
2001 Agricultural Intensification Versus Extensification: A Case Study of Deforestation in the Northern-Hill Region of Vietnam. Journal of Environmental Economics and Management 41(1): 44–69.

Tainter, Joseph A.
1988 The Collapse of Complex Societies. Cambridge: Cambridge University Press.
2006 Archaeology of Overshoot and Collapse. Annual Review of Anthropology 35: 59–74.

Tanda, Giuseppa
2009 Il Neolitico recente. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 59–71. Florence: Istituto Italiano di Preistoria e Protostoria.

Thomas, Nicolas
1991 Entangled Objects: Exchange, Material Culture, and Colonialism in the Pacific. Cambridge, Massachusetts: Harvard University Press.

Trigger, Bruce G
2003 Understanding Early Civilizations: A Comparative Study. New York: Cambridge University Press.

Tronchetti, Carlo
1986 Nuragic Statuary From Monte Prama. *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 41–59. Ann Arbor: University of Michigan Press.

Trump, David
1984 The Bonu Ighinu Project and the Sardinian Neolithic. *In* Studies in Sardinian Archaeology. Miriam S. Balmuth and Robert J. Rowland Jr., eds. Pp. 1–22. Ann Arbor: University of Michigan Press.
1986 Beyond Stratigraphy - The Bonu Ighinu Project. *In* Studies in Sardinian Archaeology, Volume II: Sardinia in the Mediterranean. Miriam S. Balmuth, ed. Pp. 9–17. Ann Arbor: University of Michigan Press.

Tuzin, Donald
2001 Social Complexity in the Making. A Case Study Among the Arapesh of New Guinea. London: Routledge.

Tykot, Robert H.
1992 The Sources and Distribution of Sardinian Obsidian. *In* Sardinia in the Mediterranean: A Footprint in the Sea. Robert H. Tykot and Tamsey K. Andrews, eds. Pp. 57–70. Sheffield: Sheffield Academic Press.

Tylecote, R. F., Miriam S. Balmuth, and Raniero Massoli-Novelli
1984 Copper and Bronze Metallurgy in Sardinia. *In* Studies in Sardinian Archaeology. Miriam S. Balmuth and Robert J. Rowland Jr., eds. Pp. 115–162. Ann Arbor: University of Michigan Press.

Ugas, Giovanni
2009 Il I Ferro in Sardegna. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 163–182. Florence: Istituto Italiano di Preistoria e Protostoria.

Usai, Luisanna
2009 Il Neolitico medio. *In* Atti della XLIV Riunione Scientifica: La Preistoria e la Protostoria della Sardegna. Cagliari, Barumini, Sassari 23-28 novembre 2009. Volume I - Relazione generali. Carlo Lugliè and Riccardo Cicilloni, eds. Pp. 49–58. Florence: Istituto Italiano di Preistoria e Protostoria.

Vasey, Daniel E.
1992 An Ecological History of Agriculture, 10,000 B.C. - A.D. 10,000. Ames, Iowa: Iowa State University Press.

Veal, Robyn
2012 Pran'e Siddi Charcoal: Preliminary Report. Unpublished. Rome: British School at Rome.

Warren, P. M.
1972 Myrtos: An Early Bronze Age Settlement in Crete. BSA Suppl., 7. London: Thames & Hudson.

Wason, P.
1994 The Archaeology of Rank. Cambridge: Cambridge University Press.

Watts, W.A., J.R.M. Allen, B. Huntley, and S.C. Fritz
1996 Vegetation History and Climate of the Last 15,000 Years at Laghi Di Monticchio, Southern Italy. Quaternary Science Reviews 15: 113–132.

Webster, Gary S.
1988 Duos Nuraghes: Preliminary Results of the First Three Seasons of Excavation. Journal of Field Archaeology 15: 465–472.
1990 Labor Control and Emergent Stratification in Prehistoric Europe. Current Anthropology 31(4): 337–347.
1991 Monuments, Mobilization, and Nuragic Organization. Antiquity 65: 840–856.
1996 A Prehistory of Sardinia 2300-500 BC. Monographs in Mediterranean Archaoelogy, 5. Sheffield: Sheffield Academic Press.

Webster, Gary S., and Maud R. Webster
1998 The Duos Nuraghes Project in Sardinia: 1985-1996 Interim Report. Journal of Field Archaeology 25(2): 183–201.

Weiss, Harvey, and Raymond S. Bradley
2001 What Drives Societal Collapse? Science 291(5504): 609–610.

Wiessner, Polly
1996 Leveling the Hunter: Constraints on the Status Quest in Foraging Societies. *In* Food and the Status Quest: An Interdisciplinary Perspective. Polly Wiessner and Wulf Schiefenhövel, eds. Pp. 171–191. Providence: Berghahn Books.

Willey, Gordon R.
1953 Prehistoric Settlement Patterns in the Viru Valley, Peru. Smithsonian Institution Bureau of American Ethnology Bulletin, 155. Washington D.C.: United States Government Printing Office.

Williams, Nancy M.
1982 A Boundary Is to Cross: Observations on Yolngu Boundaries and Permission. *In* Resources Managers: North American and Australian Hunter-Gatherers. Nancy M. Williams and Eugene S. Hunn, eds. Pp. 131–153. American Association for the Advancement of Science Selected Symposia Series. Canberra: Australian Institute of Aboriginal Studies.

Wittfogel, Karl A.
1957 Oriental Despotism: A Compartive Study of Total Power. New Haven: Yale University Press.

Woodburn, James
1982 Egalitarian Societies. Man 17: 431–451.

Wright, Henry T.
1977 Recent Research on the Origin of the State. Annual Review of Anthropology 6: 379–397.
1984 Pre-state Political Formations. *In* The Evolution of Complex Societies: The Harry Hoijer Lectures for 1982. Timothy K. Earle, ed. Pp. 41–77. Malibu, California: Undena Publications.

Wright, James C., ed.
2004 The Mycenaean Feast. Princeton: The American School of Classical Studies at Athens.

Zohary, Daniel, and Pinhas Spiegel-Roy
1975 Beginnings of Fruit Growing in the Old World. Science 187(4174). New Series: 319–327.