Settlement Pattern Studies in Polynesia: Past Projects, Current Progress, and Future Prospects

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Abstract and Keywords

Settlement pattern archaeology has had a major impact on archaeological research in Oceania. This article reviews the history of the settlement pattern approach in Polynesia and provides case studies from the archipelagos of Samoa and Hawai'i. The primary theoretical and methodological foundations and limitations of settlement pattern archaeology are discussed. Recent technological innovations in spatial analysis, including remote sensing, computer analysis, and geographical information systems, are presented. Finally, the chapter concludes with a brief discussion of current and future avenues of development for settlement pattern studies, including the use of remote sensing technology and non-site approaches to archaeological survey and recording.

Keywords: settlement pattern, Polynesia, remote sensing, non-site archaeology, Samoa, Hawai'i

Introduction

Following the influence of Steward's cultural ecology (Steward 1937; see O'Brien et al. 2005) and the pioneering work of Gordon V. Willey (Willey 1953), American archaeology of the 1950s saw a greater focus on the understanding of regional patterns in archaeological data sets. This new attention to regional-scale spatial patterning ultimately led to a revision of many of the fundamental archaeological questions regarding social organization, land use, demography, and cultural variation (for a review of the foundations of settlement pattern studies in archaeology, see Parsons 1972). Since these foundational studies nearly sixty years ago, settlement pattern research has produced extensive amounts of data across a variety of regions worldwide and continues to be a major focus of archaeological research projects today (for a recent review, see Kowalewski 2008).

Early settlement pattern studies focused predominantly on locales in North and South America (e.g., Willey 1953; MacNeish 1964). However, the following decade witnessed the emergence of Oceania as an important region for the development of the settlement pattern approach, largely due to work by Roger C. Green, one of Willey's previous students at Harvard (e.g., Green 1963, 1967). By the mid-1970s, extensive settlement pattern projects had been conducted across a number of Polynesian islands and archipelagos, including Hawai'i (e.g., Green 1969, 1970, 1980; Rosendahl 1972; Tuggle and Griffin 1973; Kirch and Kelly 1975), Samoa (Green and Davidson 1969, 1974; Davidson 1969), New Zealand (Green 1963, 1970; Groube 1964; Kennedy 1969), and Rapa Nui (McCoy 1976). These research projects provided the foundations for many regional-scale archaeological investigations that would be conducted over the next forty years (e.g., Campbell 2001; Vargas et al. 2006; Ladefoged et al. 2008, 2009; Stevenson and Haoa Cardinali 2008; Kirch 2010, 2014; Kirch et al. 2012; Maric 2012; Morrison 2012; Mulrooney 2013).

This chapter begins by introducing the foundations, goals, and definitions of settlement pattern archaeology. Then detailed expositions of select settlement pattern studies in Samoa and Hawai'i are presented. We next explore a number of methodological and theoretical issues in current settlement pattern research, including the difficulty of managing and

analyzing large regional data sets, the dilemma of determining spatial association and temporal contemporaneity in surface features, and methods for constructing aggregate scale settlement units. Recent technological innovations in spatial analysis, including remote sensing, computer analysis, and geographical information systems, are presented in the context of improving the archaeological methods relevant to settlement pattern recording and analysis. We conclude by considering the future of settlement pattern archaeology in light of the time-perspectivism paradigm.

The Foundations of Settlement Pattern Studies in Archaeology: Definitions and Goals

Gordon Willey originally defined settlement pattern as "the way in which man disposed himself over the landscape on which he lived. It refers to dwellings, to their arrangement, and to the nature and disposition of other buildings pertaining to community life" (Willey 1953: 1). In a more recent article, Stephen Kowalewski defines settlement pattern as "the regularities formed by the distributions of multiple places where people lived or carried out activities, including regularities in the relations of these places and activities to each other and to other features of the environment" (Kowalewski 2008: 227).

Although separated by nearly sixty years, both of these definitions identify at least two broad influences on human settlement. First, the natural environment influences where people conduct many of their necessary daily subsistence and survival activities. Studies that examine the relationship between human organization and ecological setting generally focus on human adaptation, the selective environment for human evolution, and variation in land use across space and time in concert with environmental variability. Second, since humans are social animals, many of the activities and tasks that they participate in are also influenced by the location, size, and arrangement of the other social groups with whom they interact. Researchers examine social relationships between communities and attend to the development of different forms of human spatial organization, such as the rise of social hierarchy and heterarchy, and competition and cooperation between and within social groups. The combined influence of these two broad factors requires that settlement pattern studies focus on both natural ecological and social environments and the ways in which they influence the configuration of the archaeological record (Kirch 1985: 247; see also Fish 1999).

While settlement pattern studies focus on multiple factors that can influence how human social organization manifests on the landscape, an additional important insight is that the archaeological record is a result of human societies that are organized at a variety of spatial scales depending on the social structure and the patterns of interaction between neighboring social groups. Bruce Trigger (1967) recognized that patterning of archaeological phenomena was inherently multi-scaled and advocated the use of a three-tier system encompassing the household, community, and region. Patterns at these three corresponding spatial scales were ultimately explained in terms of functional processes related to the social, economic, and political forces that influence organization at each corresponding structural scale. Ultimately, the settlement pattern approach was based on the use of archaeological materials to reconstruct a functioning settlement-subsistence system during a specific time period and thus provide some indication of the characteristics of communities that occupied the settlements. Settlement pattern studies were therefore often reconstructionist in orientation and directed toward documenting short-term phenomena often akin to ethnographic categories (Dunnell 1992: 27; Wandsnider 2004: 51–52).

Roger Green acknowledged the potential of a regional perspective for understanding adaptations to the natural environment in the social, economic, and political realms of Pacific societies. In the early 1960s, Green initiated research to determine the archaeological sequence of Auckland Province on the North Island of New Zealand. Green used extensive archaeological survey data and post-contact historical resources to create a diachronic model of population expansion, settlement organization, and subsistence intensification. "A Review of the Prehistoric Sequence of the Auckland Province" (Green 1963) served as a model for future large-areal studies and foreshadowed Green's research in Samoa and the Society Islands (Green 1970). Further work in the 'Opunohu Valley of Moorea, French Polynesia (Green 1967), examined population distribution in relation to local ecology and greatly contributed to Green's regional comparative study of Polynesian settlement. Green's early research set the stage for future Society Island exploration, including the expansion of archaeological investigations at 'Opunohu (Kahn 2004) and studies of intra-regional variability in pre-contact political structure in relation to local environmental parameters (Maric and Cauchois 2009; Maric 2012).

Settlement Patterns in the Samoan Islands

The Samoan Islands hold a unique position in the prehistory of Polynesia as they mark the most eastern geographic

extent of the Lapita expansion. As a consequence of the relatively long period of settlement in Tonga and Samoa, researchers have been particularly interested in understanding the in situ development of Polynesian culture (Green 1986; Kirch 1997; cf. Smith 2002). One aspect of Polynesian cultural development that has been explored in depth by a number of archaeologists is the evolution of Samoan social organization, including changes in settlement pattern, land use, and ceremonial architecture.

Settlement pattern archaeology in the Samoan archipelago was initiated by Roger Green, Janet Davidson, and colleagues during the mid-1960s (Davidson 1969; Green and Davidson 1969, 1974; Green 1970). The majority of their field surveys and excavations were concentrated on the island of ʻUpolu and focused predominantly on identifying the full range of archaeological materials residing on the surface of the landscape. Green, Davidson, and colleagues documented variability in representative samples of settlement features, their distribution, the nature of specialized community structures, and the function of a range of domestic features. Paying particularly close attention to intra-settlement social organization, they identified a series of residential structures including dwellings and cookhouses. Several larger structures, including the *fale tele* and *fale aitu,* were found at larger spatial scales and used to identify community-scale settlement units. The spatial relationship of domestic features to community features was established based on an analysis of the distribution of surface structures. Limited excavation of a range of feature types within and between settlements then allowed Green and Davidson (see also Davidson 1969) to develop a basic chronological model of settlement pattern across ʻUpolu.

Over the course of the next five decades settlement pattern research would extend into new regions of ʻUpolu and Savaiʻi (Jennings et al. 1976; Jennings and Holmer 1980) and across the other islands of the Samoan archipelago incorporating detailed studies on the islands of Tutuila (Clark 1993; Clark and Herdrich 1993; Pearl 2004; Addison and Asaua 2006; Addison et al. 2006; Eckert and Welch 2013; Cochrane et al. 2013) and the Manuʻa Islands (Kirch and Hunt 1993; Quintus 2012; Quintus and Clark 2012). The earliest evidence for the settlement of the Samoan Islands comes from a single Lapita pottery deposit at the Mulifanua Ferry Berth site (see essays by Burley and Addison, and Cochrane) that is now submerged under water as a result of tectonic subsidence (Dickinson and Green 1998; Dickinson 2007). Radiocarbon dates place occupation of Mulifanua somewhere between 3000 and 2600 cal. B.P. (Petchey 2001; Rieth et al. 2008). Based on bathymetric modeling, Green (2002) suggests that although only one Lapita pottery deposit has been found in the Samoan archipelago, the presence of other contemporaneously aged deposits in similar ecological contexts is highly likely. However, many of these deposits would be difficult to locate due to island subsidence and landscape alterations over the last three millennia. Rieth et al. (2008) and Morrison et al. (2010) generally agree with Green's conclusion, but suggest, based on Geographical Information Systems (GIS) analysis, that Lapita colonization in the Samoan archipelago may have been limited in many areas due to a lack of suitable locations for expansive settlement 3,000 years ago.

After Lapita pottery, the second general chronological period of Samoan prehistory is "The Period of Polynesian Plainware Ceramics" (Green 2002: 136; see also Rieth and Hunt 2008), characterized by a loss in dentate-stamped pottery and a decrease in vessel form variants (Rieth and Hunt 2008: 1903). Recent reanalysis of the entire suite of radiocarbon dates from Samoa by Rieth and Hunt (2008; see also Rieth et al. 2008) suggests that there may be an approximately 200–500 year gap between the Lapita site at Mulifanua and the next earliest deposit containing Plainware pottery at Toʻaga on Ofu Island. If this pattern is a result of an actual lack of settlements in Samoa during this time period rather than a result of sampling bias, the situation would be anomalous when compared to the nearby Tonga and Fiji archipelagos which boast clear evidence for continued settlement from Lapita onward (see Addison and Morrison 2010; essays by Burley and Addison, and Cochrane).

Coastal settlements with post-Lapita plainware pottery are found at locations such as Faleasiʻu on ʻUpolu (Green 2002), Falemoa on Manono (Jennings and Holmer 1980), Tau Village on Tau (Hunt and Kirch 1988), and Vailele and Jane's Camp on ʻUpolu (Jennings and Holmer 1980). However, it is during this time period where we begin to see the first evidence of inland expansion and use for agriculture and settlement (Green 2002; Rieth and Hunt 2008; Eckert and Welch 2013). For example, at Falefa Valley and Luatuanuʻu, ʻUpolu, there is evidence for burning, perhaps for initial agricultural clearing (Rieth and Hunt 2008: 1904), and the Falefa Valley on ʻUpolu probably supported dense populations during the first few centuries A.D. (Green and Davidson 1974: 216–217; Green 2002: 137). The use of inland zones is documented by the presence of plainware sherds at a number of locations including Pulemelei, on Savaiʻi (Martinsson-Wallin et al. 2007), Vaipito, Tutuila (Addison and Asaua 2006), Aunuʻu (Clark 1996), Leone Valley, and Vainuʻu (Eckert and Welch 2013).

The period spanning from approximately 1500 to 1000 B.P. is generally considered a "Dark Ages" in which there is very little information regarding Samoan settlement and social organization (Davidson 1979: 94–95). Yet the absence of data from this time period presumably reflects the aceramic nature of these archaeological deposits and general sampling bias rather than a real pause in human activity (Green 2002: 140; Rieth and Hunt 2008: 1904), as both coastal and inland locations continued to be occupied during this time period (Rieth and Addison 2008).

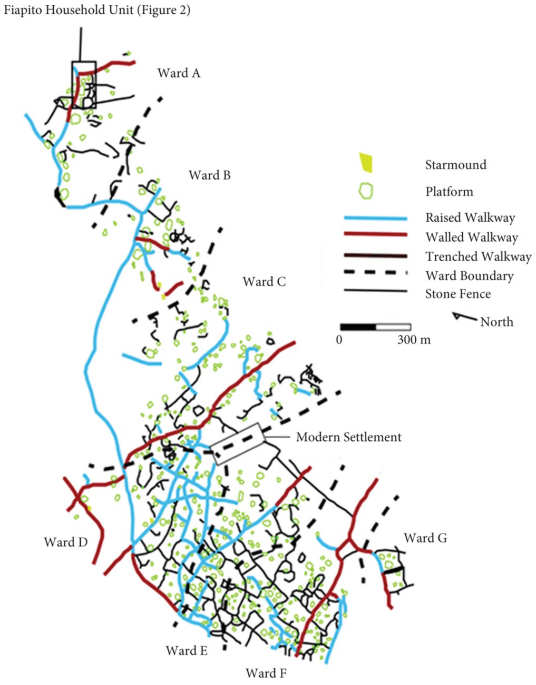

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Figure 1 The Mount Olo settlement pattern depicting multiple organizational units ranging from discrete platforms, household units, residential wards, and villages

(modified from Jennings and Homer 1980).

Beginning around 1000 cal. B.P., the traditional Samoan village began to take on its familiar form, and it is from this time period that the greatest amount of community patterning data is available for comparative analysis. The characteristics of the traditional Samoan village include extensive residential remains, communal monumental structures, and agricultural features (Figure 1). The house or *fale* is the basic residential unit often represented by raised mounds or platforms paved with coral or water-worn gravel floors known as *'ili'ili* and at least partially enclosed by stone walls and paths (Green and Davidson 1969; Jennings and Holmer 1980: 3) (Figure 2). The household unit (HHU) (Jennings et al. 1982; Green 2002) is recognized as a set of aggregate-scale archaeological features above the scale of the individual *fale*, including residential stone or earthen mounds and/or platforms of various sizes, raised and/or sunken walkways, stone walls, and large raised-rim earth ovens (Rieth and Hunt 2008: 1904).

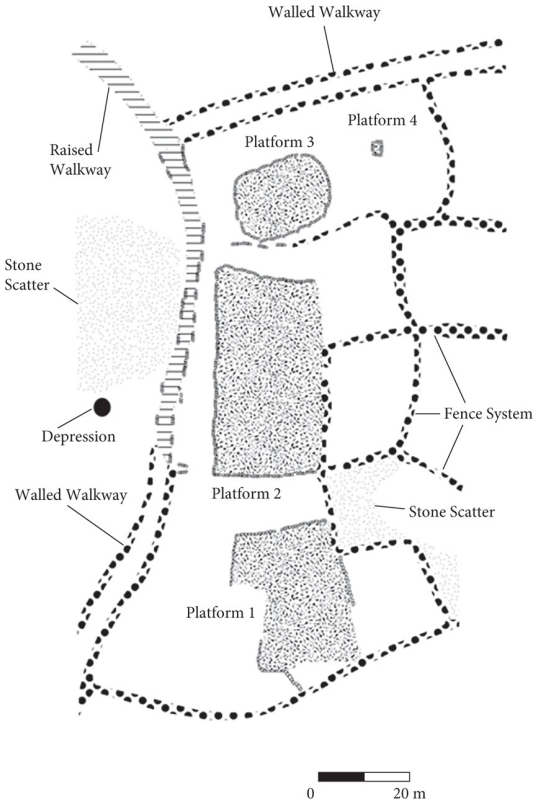

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Figure 2 The Fiapito household unit (HHU) is an example of discrete residential platforms and higher scale units of clusters of archaeological features which ultimately make up the settlement pattern at Mount Olo

(modified from Jennings and Homer 1980).

The *nu'u* or village and the *pitonu'u* or subvillage exist at scales above the HHU (Jennings et al. 1982: 84; Clark and Herdrich 1993: 15). Jennings et al. (1982) equate the *pitonu'u* with the residential ward. Each ward is a cluster of HHUs thought to represent a "lineage that resides together in a grouped domiciliary area" (Jennings et al. 1982: 84). Large platforms, considered to be the houses of higher status individuals, are often present within each ward. The *nu'u* is identifiable by the presence of communal structures such as the *malae*, the *fale tele*, and the *fale aitu*. The *malae* is an open communal space used for political or ceremonial functions. The *fale aitu*, or god's house, is a ceremonially important structure that varied in size and was sometimes located on the periphery of the village (Davidson 1969). The *fale tele*, or community house, is represented by house platforms with larger than average floor sizes. Jennings et al. (1982) investigated the chronology and organization of Samoan villages in three distinct archaeological settings and one modern context on the islands of 'Upolu and Savai'i. Through extensive archaeological mapping and a targeted excavation strategy they conclude that "the use of space, the use of HHU boundaries, the importance of rank in disposition of households along the paths, and other organizing principles appear to have been stable for 500–600 years on both Savai'i and 'Upolu" (Jennings et al. 1982: 100).

Other archaeological surface feature classes appear on the landscape during the second millennium A.D. These include exceptionally large earthen mounds, specialized star-shaped mounds, and fortifications. The largest and most famous mound structure is found at Pulemelei on the island of Savai'i (Green and Davidson 1969; Martinsson-Wallin et al. 2007). Also of significance are the many star-shaped mounds (*tia 'ave*) found across the entire archipelago. The most probable function of the star mound was for use in the chiefly sport of pigeon hunting (see Herdrich 1991). Investigations into the chronology of star mounds suggest that they appear late in prehistory (Davidson 1969). For example, a *tia'ave* on Mt. Olo yielded a chronometric estimate suggesting construction in the early fifteenth century (Holmer 1976; Clark and Herdrich 1993: 162). Fortifications also appear late in Samoan prehistory (Best 1993) and may indicate a period of increased competition, territoriality, and perhaps warfare (Davidson 1969: 195).

A number of outstanding questions regarding Samoan settlement patterns and inferences about regional-scale organization still remain unaddressed. First, the contemporaneity of Samoan surface features is questionable due to the

absence of clear chronological control and a relatively poor record of chronological markers. It is difficult to determine if the features used to identify and delineate households, village subsets, and villages are indeed synchronous and therefore accurately reflect the social organization of Samoan society or if these items represent the remains of different time periods, simply reflecting long-term use of the area and remnant settlement patterns (*sensus* Dewar and McBride 1992). Second, the aggregate scale unit identifications described for Mt. Olo by Jennings and colleagues were greatly influenced by ethnographic analogies to the Samoan village. Little attention was placed on building explanations regarding "why" the traditional Samoan village structure developed in the specific form that it did. Moreover, almost no information regarding the structure of settlement organization before A.D. 1000 has been identified. Lastly, concerns remain as to the adequate documentation of temporal scale for represented surface features.

Debates and difficulties aside, the settlement patterning data for Samoa during the second millennium A.D. suggest that social organization was primarily centered at the level of the nucleated village with lower scale units corresponding to subsets of the village (*pitonu'u*) and domestic households identified in the archaeological record. There is no indication of larger scale cohesive organizational units corresponding to districts or entire islands, a pattern that differs from the late pre-contact settlement pattern in the Hawaiian Islands where we now place our attention.

Settlement Patterns in the Hawaiian Islands

The Hawaiian Islands are noted by many anthropologists for the high degree of cultural complexity and status differentiation described by both European voyagers and native ethno-historians (e.g., Beckwith 1932; Kamakau 1992; Malo 2005). Kirch (2010) and Hommon (1976, 2013) have argued that pre-contact Hawaii should be classified as a state-level society rather than chiefdom based on extensive archaeological and ethno-historic evidence. While the use of a typological classification to organize cultures is problematic for a number of theoretical and methodological reasons (see Leonard and Jones 1987), these recent studies by Kirch and Hommon are important because they highlight the substantial variability in social organization within the island cultures of Polynesia. The inhabitants of the Polynesian islands share common ancestry, but historical and ecological factors have resulted in different patterns of land use and community organization reflected in the archaeological record of settlement.

Late pre-contact traditional Hawaiian social organization consisted of a nested set of hierarchically organized social units assembled at various spatial scales often corresponding to island geography (Hommon 2013). The largest geographical scales are the *moku*, a politically independent island or island segment, and the *pae-moku*, a unified aggregation of islands (Malo 2005: 16; Kirch 1985: 2). Examples of organization at this scale are the unification of O'ahu Island by the *ali'i* Ma'ilikukahi (Kirch 2010: 112), or the consolidation of Hawai'i Island, and ultimately Moloka'i, Maui, and O'ahu, into a single political entity by Kamehameha (Cordy 2000). Individual islands were subdivided into districts in which existed radial territorial units of various sizes called *ahupua'a* stretching inland from the coast. Each *ahupua'a* encompassed a full range of economic zones, including coastal marine resources, agricultural lands, and forested regions with important wild flora and fauna. Ideally, an *ahupua'a* was economically self-sufficient. On older islands with well-defined streams and valleys, *ahupua'a* generally correspond to watersheds with boundaries demarcated by topographic features such as ridge-lines. *Ahupua'a* boundaries were also designated on younger islands that lacked these well-defined topographic features (Kirch 2010: 47). At the time of European contact there were at least 600 *ahupua'a* on Hawai'i Island alone (Cordy 2000: 31), many demarcated by extensive stone walls and alignments still visible on the surface of the landscape today.

The *ahupua'a* formed the primary economic and administrative unit of the Hawaiian archipelago, but there were also organizational units at spatial scales below the *ahupua'a*. For example, *ili* consisted of clusters of residential features and agricultural plots usually on irrigable stream segments or strips of volcanic flows (Kirch 2010: 48). *Ili* were administered by a local *konohiki*, or chiefly land administrator, who was appointed to oversee the corresponding *ahupua'a* (Cordy 2000: 33). *Ili* were further subdivided into agricultural plots called *mo'o*, which were generally worked by a single residential group. David Malo, the Hawaiian historian, describes even further subdivisions of *mo'o* into finer scale land divisions of *pauku, kihapai, koele, kaku-one*, and *kuakua* (Malo 2005: 16).

The traditional land tenure hierarchy in Hawaii must be examined in light of a broad demarcation between two social classes, the chiefly landowners (*ali'i*) and the landless commoner (*makaainana*). The nested and hierarchical structure of Hawaiian social organization in place by the late eighteenth century is a reflection of the administrative control and taxation of the agricultural production of the *maka'ainana* class by the *ali'i*, and it is perhaps this aspect that most greatly

distinguishes Hawaiian social organization from the other island cultures of Polynesia (Kirch 2010; Hommon 2013). The sharp distinction between hereditary based social stratification and land tenure rights is reflected in the hierarchy of organizational units and the pattern of settlement indicated in the archaeological record (Hommon 2013). However, we must address the question of how Hawaiian social organization came to possess such sharp hierarchical social distinctions and how researchers use archaeological data to understand the diachronic development of late pre-contact Hawaiian society.

Like elsewhere in Polynesia, the archaeology of Hawai'i is replete with a variety of stone structures residing on the surface of the landscape. This variety not only reflects different functional tasks and activities related to the agricultural, religious, and domestic aspects of life but also the organizational structure and hierarchical nature of Hawaiian society in general. As is the case with the Samoan settlement pattern example discussed earlier, at the lowest spatial scale exist individual architectural components consisting of aggregates of rocks forming alignments, walls, terraces, pavements, and hearths (see Kirch 1985; Weisler and Kirch 1985). These *architectural components* are often found in isolation or aggregated into larger *features* constructed out of intersecting and/or abutting *architectural components*. Often times, several *feature*s are found abutting and form interconnected entities referred to as *compound structures* (Kirch 1985; Weisler and Kirch 1985).

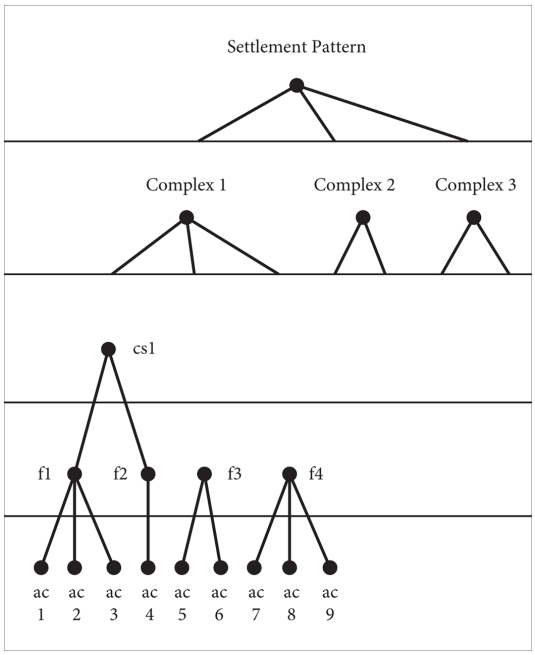

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Figure 3 The relationship between different unit scales ranging from discrete architectural components (ac), features (f), compound structures (cs), complexes, and settlement patterns

(adapted from Kirch 1985).

Note that unconnected arcs and nodes depict a break in the physical spatial connections between archaeological remains. Connected arcs and nodes are indicative of bounded physical entities.

Weisler and Kirch (1985; see also Kirch 1985) suggest that determining a settlement pattern requires first identifying sets of spatially and temporally related archaeological *complexes*, which themselves are made up of aggregated sets of lower scale *architectural components* and *features*. While in many cases the relationship between *architectural components, features*, and *compound structures* is demarcated by the spatial connection of abutting and aligning structural components, identifying archaeological units at the next highest spatial scale, the *complex*, requires some explicit method for determining spatial associations between sets of spatially disconnected *features* (Figure 3). The ability for archaeologists to identify and examine human landscape use at various aggregate scales requires consistent methods of spatial and temporal unit construction, a task that often proves difficult and requires a specific set of analytic methods and protocols (Dye 2010).

Archaeologists study the spatial and temporal characteristics of archaeological remains to understand how land use and social organization change together through time. How does the variety of stone architectural features, complexes, and

overall settlement pattern reflect the hierarchically nested nature of Hawaiian social organization and reveal important aspects of its development? Perhaps the most extensive set of case studies exploring the relationship between spatial organization, environmental variability, and diachronic development comes from the Hawai'i Biocomplexity Project (e.g., Kirch et al. 2004, 2012; Vitousek et al. 2004; Ladefoged and Graves 2006, 2007, 2008; Lee et al. 2006; Ladefoged et al. 2008; Lee and Tuljapurkar 2008, 2010). "The Hawai'i Biocomplexity Project is a multidisciplinary collaboration among archaeologists, demographers, ecologists, soil scientists and others focused on a millennium-scale sequence of linked demographic change" (Kirch et al. 2012: 18). One of the primary goals of the project was to document how variation in agricultural food production dynamics resulted in the emergence of hierarchical sociopolitical structure in the Hawaiian Islands. Comparative settlement pattern analyses were conducted at both the household and *ahupua'a* scales of organization (e.g., Graves et al. 2002; Ladefoged and Graves 2006; Ladefoged et al. 2008; Field et al. 2010, 2011), and comparisons between agricultural production levels and the expansion, segmentation, and intensification of field production systems and land use were documented (Ladefoged et al. 2003; Ladefoged and Graves 2006, 2007, 2008; Ladefoged et al. 2011; Kirch et al. 2012).

The Kohala field system of leeward North Kohala has been a prolific source of archaeological data, with the documentation of residential, religious, and agricultural features at the landscape scale. The pattern of landscape modification in the field system corresponds to elevation and substrate parameters beneficial to agricultural production (Chadwick et al. 2003; Vitousek et al. 2004; Lee et al. 2006) and the settlement patterns apparent at Kohala are directly related to natural resource distributions and the differential presence of suitable conditions for agriculture. Based on intensive research regarding the development and expansion of the *ahupua'a* system in north Kohala, Ladefoged and Graves (2006, 2007, 2008) propose that the area was originally divided into nine *ahupua'a* units as early as A.D. 1400 (Ladefoged et al. 2008: 95) and further partitioned into as many as thirty-two separate *ahupua'a* by the mid-nineteenth century. Environmental, topographic, and climate analyses suggest that a model territorial system in which residents lived autonomous lives, free of the demands of tribute and surplus production, would ultimately coalesce in fourteen territorial units. Subsequent division of the landscape into thirty-two territories "would have lowered the life expectancy of the residents confined to some territories relative to the others, but boosted potential surplus production and tempered year-to-year variation in surplus" (Ladefoged et al. 2008: 108). Consequently, the expansion of *ahupua'a* likely reflects increased hierarchical organization and social stratification at an organizational scale above that of the *ahupua'a*.

Archaeological research at the scale of individual households also corroborates the results of the *ahupua'a* scale analysis. Field et al. (2010, 2011) document changing household organization within two individual *ahupua'a* in leeward Kohala. Transformations in the size, structure, and location of residential features and complexes (*kauhale*) that occurred during the three to four centuries preceding European contact (see also Weisler and Kirch 1985) imply a shift in the mode of production (*sensus* Sahlins 1972) from one centered upon domestic management to an economy based on elite social power and surplus. The two *ahupua'a* upon which Field et al. (2010, 2011) focus their analysis, *Kaiholena* and *Makeanehu*, were demarcated relatively early in the settlement and land use of the Leeward Kohala Field System, likely between cal. A.D. 1400–1500. This coincides with the initial construction and use of households within the agricultural fields. However, the majority of residential features were built between A.D. 1650–1800, and it was during this time period that the two *ahupua'a* underwent significant division as indicated in the chronology of field alignments and trails. They conclude that the exponential increase in residential structures and the growing number of differentiated social units represents a process of elite management for the collection of chiefly regulated tribute and an increase in social complexity above the scale of both the *ahupua'a* and household.

The Kohala work reveals an organizational transformation whereby definitive authority shifted over time from household, to *ahupua'a*, to district. The scale of organization documented in the Hawai'i Island example stands in contrast to the continuity of the Samoan case study, a result which seems to support Kirch (2010) and Hommon's (2013) suggestions of increasingly complex Hawaiian sociopolitical organization relative to the rest of Polynesia. Hawai'i and Samoa are but two case studies illustrating the variation inherent to island settlement structure in the Pacific. To generate comparable explanations of such variation, the classification of archaeological remains at the landscape scale must facilitate quantitative and objective identification of surface features, structural remains, and landscape modifications. Furthermore, the surface feature classes must generate useful patterns in the context of intermittently dispersed aggregate surface features in variable proximity to one another. The ability of the archaeologist to discern one surface feature from another and assess the relative density of features on a landscape depends on the discreteness of feature class definition, a notion that has plagued settlement pattern archaeology for quite some time.

Some Issues for Settlement Pattern Approaches

Despite the innovative techniques and perspectives offered by the settlement pattern approach, it is worthwhile to briefly discuss a few of the limitations and criticisms that have surfaced over the past thirty years. These range from general criticism of the functional-systems perspectives of processual archaeology (e.g., Bintliff 1991; Tilley 1994) to questions regarding the nature of archaeological phenomena, inference, and the temporal and spatial resolution necessary to answer questions often presented in settlement pattern analysis (e.g., Cherry 1983; Dunnell 1992; Wandsnider 2004). Here we identify these methodological, conceptual, and theoretical problems and discuss how they might be resolved.

First, regional settlement pattern studies require extensive geographic survey coverage that often results in the generation of cumbersome archaeological and environmental data sets. Traditional pedestrian survey methods are time- and labor-intensive and require the management of large amounts of data at a variety of spatial scales ranging from discrete artifact locations to geologic substrate information. Limitations in technology for storing, manipulating, visualizing, and analyzing these data sets previously produced gaps in the types of questions that could be effectively addressed and the effectiveness of analyses that were ultimately possible (Wandsnider 1998). However, a number of technological innovations have helped ameliorate the difficulties associated with regional scale data acquisition, management, and analysis (McCoy and Ladefoged 2009).

Remote sensing technologies, such as light detection and ranging (LiDAR) and high resolution aerial and satellite imagery, have greatly facilitated the mapping of archaeological feature distributions across island landscapes at Rapa Nui (e.g., Lipo and Hunt 2005; Bradford 2010; Morrison 2012; Ladefoged et al. 2013), Hawai'i (Ladefoged et al. 2011; McCoy et al. 2011), and Samoa (Clark et al. 2014; Quintus et al. in press). While the majority of these studies focus on the identification of agricultural features, remote sensing technologies can also be applied to the identification of residential and religious structures which when combined with less intensive pedestrian survey and targeted ground truth field work offer rapid detection and recording of archaeological landscapes. Additional technological innovations for managing regional settlement data include high-resolution Global Positioning Systems (GPS) units and GIS. These computer-based technologies now afford archaeologists the opportunity to collect highly accurate positional information that can be integrated in a spatial database framework.

A second and more serious methodological limitation of the regional settlement pattern approach is the difficulty of determining contemporaneity among surface features (Cherry 1983; Schacht 1984; Dewar and McBride 1992; Wandsnider 2004). As mentioned earlier, one of the initial goals of settlement patterns studies was to acquire a better understanding of the relationship between ecological and settlement-subsistence systems to explain temporal changes in human spatial organization. Therefore, determining spatial associations through sophisticated technological applications only solves half of the puzzle and temporal control still remains a fundamental concern (Bailey 2007). The portion of the archaeological record used to document settlement patterning is never a snapshot of a functioning settlement-subsistence system but instead a time-averaged amalgamation of the result of different processes operating at a variety of spatial and temporal scales (Bailey 2007, 2008). Moreover, differential destruction of the surface archaeological record through a variety of natural and human processes may create an unrecognized bias in settlement pattern research. Consequently, some archaeologists have even questioned if the goals of the settlement pattern approach as initially formulated during the New Archaeology are achievable (e.g., Wandsnider 2004).

Surface structures present a particularly difficult problem for archaeologists because of the inability to date many construction events. As a consequence, the temporal relationships among architectural features are often unclear. Recognizing the importance of chronological control for assessing important diachronic questions in Hawaiian settlement and organization, Dye (2010) developed a Bayesian approach for dating surface architecture and other potentially useful techniques for determining the temporal characteristics of surface features include uranium series dating, thermal and optically stimulated luminescence (OSL), and cosmogenic nuclide dating. The direct absolute dating of surface material has been conducted using both OSL (e.g., Greilich et al. 2005; Vafiadou et al. 2007) and cosmogenic nuclide dating (Verri et al. 2005) in other regions of the world and may hold potential for application in various Polynesian locales. Relative dating techniques such as seriation may also prove useful for sorting out chronological variability in surface architecture (e.g., Cochrane 2002; Graves et al. 2002; Mulrooney and Ladefoged 2005).

Progressively better determination of surface feature chronology may occur through continued technological development. However, certain theoretical and conceptual issues associated with the settlement pattern agenda are not as easily fixed. A continuing problem is the difficulty of specifying a systematic procedure for constructing explicitly

defined aggregate scale archaeological units that are comparable across regions and research projects (but see Kirch 1985 for an example in Hawai'i; Weisler and Kirch 1985; Sullivan 1992; Wandsnider 1998). Systematics for constructing archaeological units at the scale of settlements or regions require fundamental decisions about the basic unit of recording during archaeological surveys and multi-scale techniques for constructing analytical units (e.g., Foley 1981; Dunnell and Dancey 1983; Dunnell 1992; Ebert 1992).

Explaining human social organization at multiple scales requires archaeological units constructed at a variety of corresponding levels. One of the primary difficulties for archaeologists operating from a settlement pattern approach has been the creation of comparable archaeological units above the level of the discrete artifact (Dunnell 1971). For example, when constructing analytical classes defined by attributes of discrete artifacts, such as edge angle, length to width ratio, or other technological characteristics, it is a general assumption (although not necessarily true) that each attribute was created fairly closely in time. Therefore, the discrete artifact allows the archaeologist to make inferences about the spatial and temporal association of its attributes because the spatial boundaries of the artifact place clear parameters for determining these associations (Dunnell 1971; Lyman et al. 1997). However, identifying regional settlement patterns requires the systematic construction of archaeological units at levels higher than that of the discrete artifact. The spatial and temporal relationships between individual phenomena that in aggregate define units larger than artifact (e.g., household cluster) is less clear, since the boundaries between phenomena are not contiguous, unlike the boundaries between attributes of a single artifact.

Constructing archeological units above the level of artifact also has ramifications for archaeological survey procedures. If we identify settlements as aggregates of surface features and discrete artifacts, then the lowest level of field recording must be the discrete artifact (Dunnell 1992; Lipo and Dunnell 2008). With this non-site approach, the sometimes unjustified identification of units, by drawing lines around sets of surface features, is eschewed in favor of measurements of relative artifact density and the spatial distribution of functional classes (e.g., fire feature, midden, agricultural plot). These data can then be examined through reproducible spatial analyses and statistics to create settlement pattern units (e.g., Peterson and Drennan 2005; Lipo and Dunnell 2008; Morrison 2012) required for documenting the spatial range of functional activities and their corresponding locales on the landscape (Foley 1981; Dunnell and Dancey 1983; Dunnell 1992; Ebert 1992).

Conclusion: Are the Goals of the Settlement Pattern Approach Attainable?

Recent critiques of the settlement pattern approach point out that using archaeological data to examine past settlement-subsistence systems reflects a functionalist reconstruction-based paradigm prevalent in the processual archaeology of the 1960s and requires unrealistic assumptions about the nature of the archaeological record (Wandsnider 2004). Of primary importance to this critique is recognition that the long-term accumulation of the archaeological record of past settlement and landscape use is often not well suited to investigating the nature of short-term events often phrased in ethnographic terms. For example, Dunnell notes, "Not all such clusters [i.e., archaeological settlement units] are the product of behaviors implied by ethnographic categories; nor do all ethnographic units leave high density artifact clusters. Settlements, occupation, and activities, are not agents of deposition; at best they are highly interpretive summaries of relations among such agents" (1992: 27). The archaeological record of settlement reflects cultural processes but also a multitude of other processes occurring over vastly different time-scales. Holdaway and Wandsnider (2006) sum up the situation well, stating "Why should we expect the archaeological record distributed across hundreds of years to mimic short term events?" (198).

With these criticisms in mind, are we to just abandon settlement archaeology and conclude that its original goals are ultimately unattainable? This conclusion is premature and we prefer instead to reframe the objectives and analyses of settlement archaeology using the insights of the time-perspectivism paradigm (Bailey 1983, 2007). Time-perspectivism acknowledges that the archaeological record reflects many different factors associated with geomorphologic and geologic processes, modern alteration of the landscape, and also various cultural processes, all of which play a role in structuring the archaeological record. Rather than attempt to try to reconstruct an ethnographic "snapshot" of a settlement system, time-perspectivism sees the archaeological record as contemporary phenomena that in most instances will likely never yield the kind of data necessary to reconstruct a functioning settlement system or to identify past social organization at fine temporal scales.

Using time perspectivism, we present a set of goals for future settlement pattern research in Polynesia:

1. Archaeological surveys should focus on recording the full range of phenomena from the scale of discrete artifacts to aggregates of surface features. A non-site approach is not only appropriate, but necessary.
2. Discrete archaeological features should be arranged into aggregate archaeological units through the use of multi-scale quantitative techniques aimed at identifying spatially associated archaeological features.
3. Once aggregate archaeological units are developed at explicitly defined spatial scales, they should be further investigated through a systematic dating protocol targeting individual features within each spatially associated set. These units should then be classified according to their contents and temporal characteristics.
4. The effect of site formation processes, survey bias, and geological processes on the analytical patterns should be critically assessed, identified, and incorporated into an explanation of the regional distributions in archaeological features.

Instead of relegating the surface archaeological record to a problematic time-averaged dilemma that hinders our attempts to reconstruct social organization, or alternatively simply disbelieving that any problem exists, a revised settlement archaeology will address a new set of research questions. Many of these questions will focus on building a firm understanding of why the archaeological record, a contemporary phenomenon, is configured in the specific ways that it is. Building these types of explanations will require closer attention to not only questions about past social organization and cultural processes but also other processes that influence our measurements of the archaeological record.

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