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Investigating regional patterning in archaeological remains by pairing extensive survey with a lidar dataset: The case of the Manu'a Group, American Samoa

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ABSTRACT

A long standing research approach in island Oceania is the examination of community and regional level patterning of archaeological remains. However, these efforts are impeded by heavy vegetation and rugged terrain, which limit the implementation and productivity of traditional archaeological methods. Aerial lidar data provide an opportunity to survey large archaeological landscapes effectively and efficiently in these environments. In this paper, we present the results of a lidar-based survey and analysis of community-level spatial patterning for at sites in the Manu'a Group of American Samoa. Using lidar data in conjunction with pedestrian survey results, we first established the suitability of lidar for identifying archaeological features, and then applied the technique to a previously unexamined landscape. We were able to record archaeological remains and analyse the data to discern spatial patterning in their distribution. The patterning of these remains is broadly comparable, though not identical, to that of three other settlement zones on Olosega and the adjacent island of Ofu, which previously were intensively surveyed. The differences in the characteristics and distribution of structural features within and between these four settlement zones may reflect differences in social status and ranking.

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1. Introduction

Landscape and settlement pattern studies have diversified and matured in Polynesia since the pioneering investigations of Roger C. Green in the 1960s (see Green, 2002). Settlement pattern studies have been supplemented more recently by advances in geospatial technologies (e.g., Field, 2003, 2005; Field et al., 2010; Kurashima and Kirch, 2011; Ladefoged et al., 2009, 2013; McCoy et al., 2011a,2011b; Morrison, 2012). Of particular importance has been the application of aerial lidar (Light Detection and Ranging) for understanding landscapes, especially in forested areas (e.g., Opitz and Cowley, 2013). Lidar datasets are just beginning to be used on some islands of the eastern Pacific for revealing the distribution of archaeological remains (Ladefoged et al., 2011; McCoy et al., 2011a), but such studies are still uncommon because datasets are available for so few islands. As lidar becomes increasingly available, however, the analyses of resultant datasets will present opportunities for more-efficient examinations of large-scale settlement patterns.

Settlement pattern studies have made important contributions to archaeological research in the Samoan Archipelago (e.g., Clark and Herdrich, 1993; Green and Davidson, 1969, 1974; Hunt and Kirch, 1988; Jennings and Holmer, 1980; Jennings et al., 1976; Pearl, 2004; Quintus and Clark, 2012). These studies, conducted within local environmental constraints, have resulted in a growing understanding of the nature and distribution of archaeological features across small sections of the landscape. Nevertheless, because of the dense vegetation and often rugged topography, the vast majority of the Samoan islands are still unexamined. Consequently, there remains a need for enhanced understanding of large regional settlement patterns and the relationships among settlement zones through time.

Using a lidar dataset that has recently become publicly available for the Territory of American Samoa, we assess the benefits and limitations of that dataset for the study of archaeological landscapes on the islands of Olosega and Ofu, in the Manu'a Group, which are the eastern-most islands of the Samoan Archipelago. By comparing the locations and configurations of upland archaeological features identified through ground survey with apparent features observed in the lidar dataset, we are able to establish a set of techniques to digitally identify and record features in an area not previously investigated on Olosega. Analyses of data from all

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of the upland settlement zones described for Ofu and Olosega demonstrate that the lidar dataset can contribute significantly to our understanding of community and regional spatial patterning of archaeological features on these islands.

2. Background

2.1. The islands

The Samoan Archipelago, located in West Polynesia, comprises nine inhabited islands: Savai'i, Apolima, Manono, 'Upolu, Tutuila, Aunu'u, Ofu, Olosega, and Ta'u. The first four islands are part of the Independent Nation of Samoa, with Savai'i and 'Upolu being the largest of the group. The latter five islands are part of the U.S. Territory of American Samoa. Ofu, Olosega, and Ta'u form the Manu'a group, which is somewhat different, environmentally and culturally, from the rest of the archipelago (Mead, 1969; Meleiseā, 1995). Of these islands, Ta'u is the largest (36 km^2), Ofu next (7 km^2), and Olosega (5 km^2) the smallest. The islands of Manu'a are located proximal to one another: Ofu and Olosega separated by a ≈100 m-wide channel, with Ta'u ≈ 10 km to the southeast. Of particular interest to this study are the interior upland zones of Ofu and Olosega (Fig. 1).

The uplands of Ofu range in elevation from ≈45 to 495 masl. Slope ranges from ≈10 to 45°, increasing with elevation. Streams are few and flow intermittently during times of heavy rain, which are frequent. On the north side of the island the elevation drops from the high ridgeline into a large area of relatively gently sloping ground that is the remnant of a volcanic caldera. The north side of the caldera is a cliff that marks the north coast of the island. Vegetation throughout the caldera and its defining slopes is a mix of native and introduced species. At lower elevations, vegetation is largely economic or secondary forests (Liu and Fischer, 2007) with equally modified understories. Rain and cloud forests grow at the higher elevations. The upland zone of Olosega ranges in elevation from ≈60 to 640 masl, and slope ranges from ≈10 to 40°. Streams are intermittent, and several dissected channels are situated near the centre of the island. Like Ofu, the vegetation is dense, in both canopy and understory, and is classified as modified/economic, secondary, or cloud/rain forest, with these zones in a linear progression from lower to higher elevations.

2.2. Settlement in the uplands

Three primary anthropogenic feature types are the focus of this study: terraces, ditches, and star mounds. Terraces are defined herein as artificially flattened earthen structures with three or less freestanding sides. These features served a variety of functions but most represent residential activities. The presence of water-worn coral and/or basalt gravel scattered over a terrace surface is taken to reflect a house/residential activity floor; the frequent presence of stone artefacts and occasional cooking features reinforces the assessment of a residential function. Larger residential terraces likely served as foundations for multiple structures that constituted individual households. Terraces that we have preliminarily designated as non-residential lack water-worn coral/basalt, artefacts, and ovens/fireplaces. These are typically smaller than residential terraces and are situated on the steeper slopes peripheral to the residential area. We tentatively propose that the non-residential terraces were related to agricultural production, either as planting terraces or as work/rest stations. Another terrace type is the ditched terrace (Quintus, 2011:84–85). These features are more-or-less oval-shaped terraces bounded entirely or nearly so by a shallow ditch. Typically, these terraces have coral paving but the corals are large, flat slabs rather than water-worn rubble. On the basis of these and other characteristics, Quintus (2011) has argued that ditched terraces were ceremonial/religious structures.

Ditches are defined as artificial channels that are longer than they are wide. The feature class is diverse, but many of these features are interpreted as drainage features given their size and spatial distribution (Quintus, 2012, 2014; Quintus and Clark, 2012). Ditches in Samoa serving functions other than fortification or sunken path are rare outside the Manu'a Group, but possible drainage ditches were briefly described for inland Falefa Valley of 'Upolu by Davidson (1974a:239) and Ishizuki (1974:49).

Star mounds are a feature type unique to the Samoan Archipelago. These structures are platforms constructed of stacked rocks or earthen fill with rock facing, having one to 11 projections on the perimeters

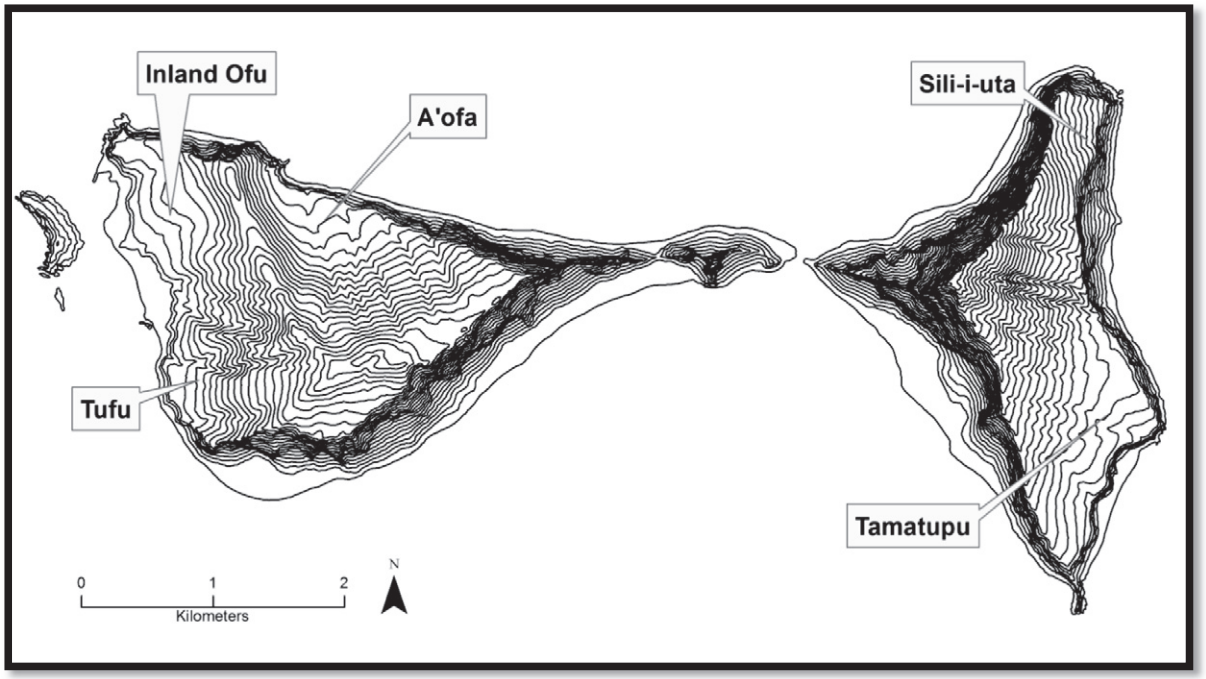

Fig. 1. Ofu and Olosega highlighting the location of named archaeological complexes.

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