Land tenure, competition and ecology in Fijian prehistory

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How do prehistoric settlement patterns relate to competition for resources? The distribution of fortified and open sites provides one indication, but using an example from Fiji, the author shows that land holding recorded in historic times may also provide a fossil of earlier competition. Comparing the land parcels and the fortified sites with the ecological zones showed that it was the richer – but less reliable – lower parts of the Sigatoka valley that were most fought over, leaving a patchwork of small defended claims, while the upper areas supported larger, co-operative land units.

Keywords: Fiji, fortifications, GIS, land tenure, patrilineal descent groups, environment, variability, evolutionary ecology

Introduction

Indigenous oral histories and the journals of European traders and colonists record the prevalence of warfare in Fiji between the eighteenth and nineteenth centuries. The importance placed upon warriors and weapons in Fijian culture and the occurrence of fortifications across the archipelago during this period also suggest that conflict and territoriality was deeply rooted in the society. Archaeological excavations indicate that fortifications and territories had developed by 1500 years BP, and persisted through later centuries as populations grew and inhabited other parts of the environment (Field 2004: 88-94). One way that the emergence and persistence of competition, territoriality and conflict can be explained is by hypotheses drawn from evolutionary ecology (e.g. Boone 1992; Durham 1976; Dyson-Hudson & Smith 1979; Halstead & O'Shea 1989; Rosenberg 1998; Smith & Winterhalder 1992). Notably, the hypothesis of 'economic defensibility' suggests that competitive and/or territorial strategies emerge in association with rich resources, as the cost of defending these resources is less than that of sharing, or foraging elsewhere (Dyson-Hudson & Smith 1979: 26).

Recent investigations of the distribution of ancient fortifications in Fiji showed that territorial strategies are also sensitive to variations in climate and consequent variability in resources (Field 2002, 2003; Parry 1977, 1982, 1987, 1997). In particular, the fluctuations in seasonal rainfall and the episodic droughts associated with the El Niño Southern Oscillation (ENSO) have been suggested as a primary factor in the development of conflict in Fijian prehistory. It continues to cause stress today. During the 18 months of the 1997-98 El

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Received: 15 April 2004; Accepted: 12 October 2004; Revised: 11 January 2005

ANTIQUITY 79 (2005): 586–600

Niño event, rainfall in Fiji was 22-42 per cent of normal, resulting in a national production loss for sugarcane of 50 per cent. The average income for subsistence farmers also dropped substantially, from F$3500 to F$1500 per annum (Kaloumaira 2000; Parry 1997; Terry *et al.* 2001).

Archaeological analyses also suggest that unpredictable perturbations in environmental productivity (e.g. droughts that vary unpredictably in duration or intensity, or unpredictable catastrophes such as severe storms or volcanic eruptions) serve to intensify a range of behavioural responses, in particular the escalation of conflict, migrations or the formation of extensive networks of co-operation and exchange (Bawden & Reycraft 2000; Ember & Ember 1992; Haas & Creamer 1993; Jones *et al.* 1999; Kennett & Kennett 2000; Raab & Larson 1997). These points are critical to understanding the context of competition, conflict and territoriality among ancient horticulturalists.

The distribution of fortifications is a primary indication of defended territory (Field 2004, and see below), but in the present case additional avenues of research were provided by social data derived from land tenure. In the twentieth century, anthropologists described the Fijian social landscape as having a 'patchwork' quality, in which the patrilineal descent groups, the *mataqali*, and their overarching ancestral lineages, the *yavusa*, were widely distributed throughout the archipelago. It was suggested that this distribution was related to conflict in Fiji's past, and the scattering of *yavusa* and *mataqali* was the outcome of many centuries of war-driven fission, migration and alliance (Capell & Lester 1941; Gifford 1952; Nadalo 1957; Nayacakalou 1955). This paper uses a geographic information system (GIS) to map the spatial distribution of fortified sites and the types of land tenure recorded for the Sigatoka Valley in the early twentieth century and then compare them with the topographic and environmental conditions as they prevail today. The results show that the pattern of land-holding relates to the degree to which it was disputed, and this in turn to its ecological and economic reliability.

The Sigatoka valley and its ecology

Located in the south-western corner of the island of Viti Levu, the Sigatoka valley covers approximately 1700km^2 of rugged mountains and drainages (Figures 1A and B). The upper Sigatoka valley is dominated by its steepness and extreme elevations, which reach well over 1100m. Much of the valley is covered with grasses and shrubs, although riparian areas and parts of the upper valley foster the growth of tropical dry forests. Subsistence in the interior was based upon horticulture, with *dalo* (*Colocasia esculenta*) and *uvi* (*Dioscorea* spp.) contributing to the bulk of prehistoric diets (Kuhlken 1994). In modern contexts, *dalo* can yield approximately 20+ tons/hectare/year in ideal conditions, can be planted year round, and harvested every 8-10 months (Brookfield 1979). However, as a hydrophilic crop, *dalo* requires running water and silty soils, and earthworks such as ponded-fields and terraces must often be installed to take advantage of water supplies and encourage vibrant growth. *Uvi* requires less investment, and is cultivated in slash-and-burn gardens that are occasionally terraced to retard erosion. With adequate amounts of rainfall, *uvi* yields between 5-15 tons/hectare/year (Kirch 1994: 8; Tindall 1983: 203). However, the plants must be allowed to germinate over the wet season, and only after 7-9 months of growth

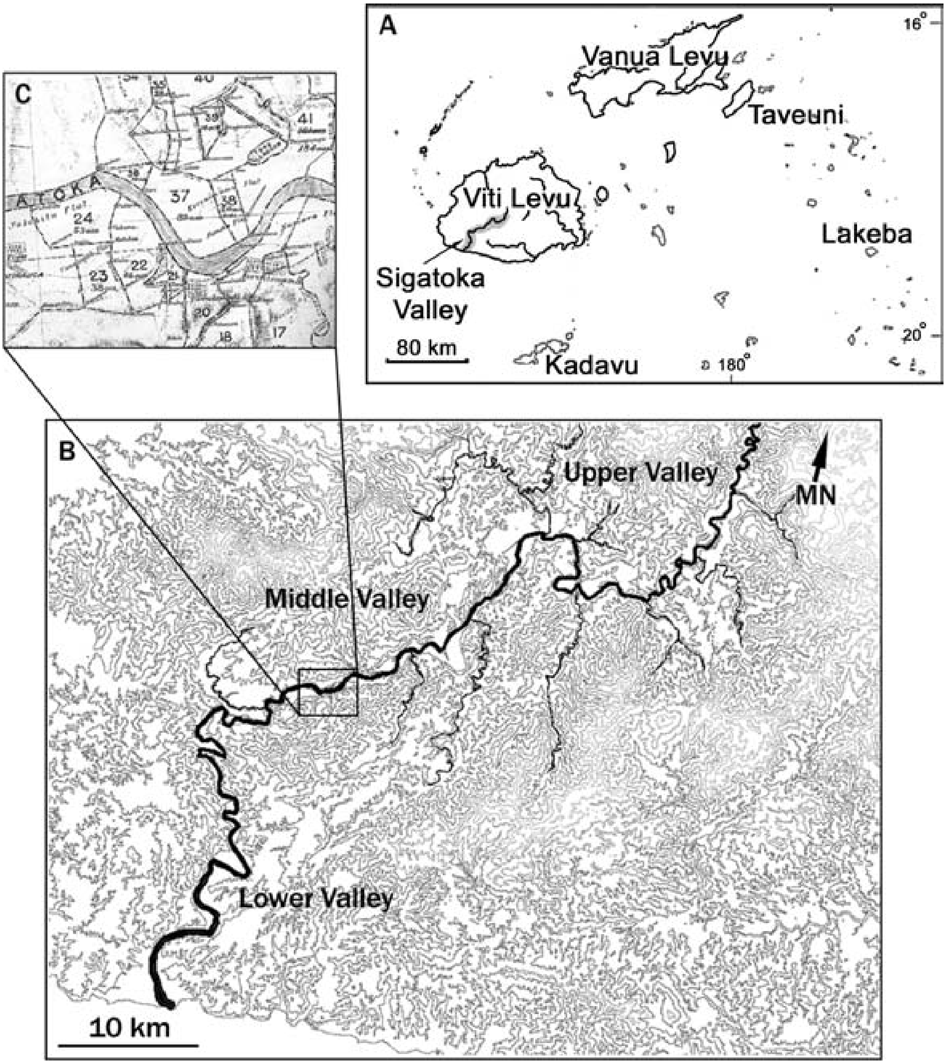

Figure 1. A) Location of the Sigatoka valley within the Fiji archipelago. B) Detailed topography of Sigatoka valley. Contour lines every 100m. C) Example of twentieth century Native Lands Commission survey map. The maps document the location and size of particular land-claims, and also note important geographical features pertaining to parcel boundaries.

with adequate rainfall do they achieve full size. Dewar (2003: 373) notes that crops that rely upon adequate and punctual rainfall are particularly insecure for farmers, as untimely droughts can effectively destroy an entire season's harvest. In sum, the dichotomy between *dalo* and *uvi* also represents the divide between resources that are unequally sensitive to seasonal variation in rainfall and unpredictable droughts.

According to Parry, all of the soils of the Sigatoka valley would have been suitable for growing non-irrigated crops such as *uvi* (Parry 1987: 25-7). As a whole, the Sigatoka valley is typified by sedimentary deposits that are moderately to highly fertile, with the best soils distributed in the middle and upper portions of the valley (Wright & Twyford 1965; Fox *et al.* 1952). However, these areas have the least amount of arable land, with much of the topography at slopes greater than 45°. This suggests that relative soil fertility would have allowed for the cultivation of *uvi* in most portions of the Sigatoka valley, although garden sizes would have been constrained by topography and also more widely distributed in both the middle and upper portions of the valley. This would have required additional travel between dispersed gardens, and perhaps impacted the net harvest size.

Modern rainfall in the Sigatoka valley is also spatially variable, with more rain falling in the higher elevations and in the upper valley. The difference in total rainfall between the wet and dry season is significant, with 75 per cent of the 1500-2250mm of rain falling between the months of December and February. However, according to data collected over the past 65 years, intra-annual rainfall can be unpredictable (Parry 1997: 20). These conditions suggest that during normal rainfall years *uvi* would have thrived along the alluvial terraces of the valley, and *dalo* cultivation would have been possible in isolated patches in the wetter uplands. However, the valley bottom and delta region have porous soils that allow for little moisture retention, and even during normal years this area can experience localised droughts. Severe and long-lasting ENSO-related droughts would have affected germination, and imposed limitations on harvest sizes for the following 10-18 months.

The intensity of the dry season and estimates of soil fertility were combined to generate three zones of cultivation and risk assessment for the Sigatoka valley (Figure 2). Zone 1 consisted of soils that experienced a strong dry season, and which ranged from high to low fertility. These factors would have made this zone the most suitable for dryland cultivation, but it was also the most unpredictable due to the combination of episodic droughts, permeable soil and the sensitivity of *uvi* to rainfall variance. Zone 2 included soils with a range of fertility levels and experienced a more moderate dry season. This zone was suited to a mixture of wetland and dryland cultivation, and would have been moderately predictable in terms of seasonal yields and year-round cultivation of *dalo*. Lastly, Zone 3 covered the regions with the weakest dry seasons, and soils that ranged from moderate to high fertility. This zone was most suited to wetland cultivation, and was least likely to experience shortfalls due to weak dry seasons. Thus due to the rainfall pattern, the higher ground (Zones 2 and 3) was also the wetter, while the area beside the river (Zone 1) was the more subject to drought.

From the perspective of evolutionary ecology, the environmental character of Zones 2 and 3 are most similar to what Dyson-Hudson and Smith proposed as the essential elements for 'economic defensibility', and territory formation. Subsistence resources, in particular *dalo*, would have been more prevalent in these regions, and could have been cultivated in dense, easily defended plots. This crop would also have been more predictable in terms of estimates of future harvests, as it can be grown year-round, and does not rely solely on rainfall for germination or full growth. Therefore, territories are expected to have formed early in Zones 2 and 3 and potentially remained stable for long periods, as the benefits of territorialism would have exceeded the costs of cultivating elsewhere. The most ancient sites, and potentially the most ancient fortifications, are expected to have been constructed in these zones. In contrast, the lands within Zone 1 were undoubtedly attractive to farmers at the outset, and likely supported a sizeable population during periods of environmental stability. But, evidence for episodic droughts suggests that this region would have suffered

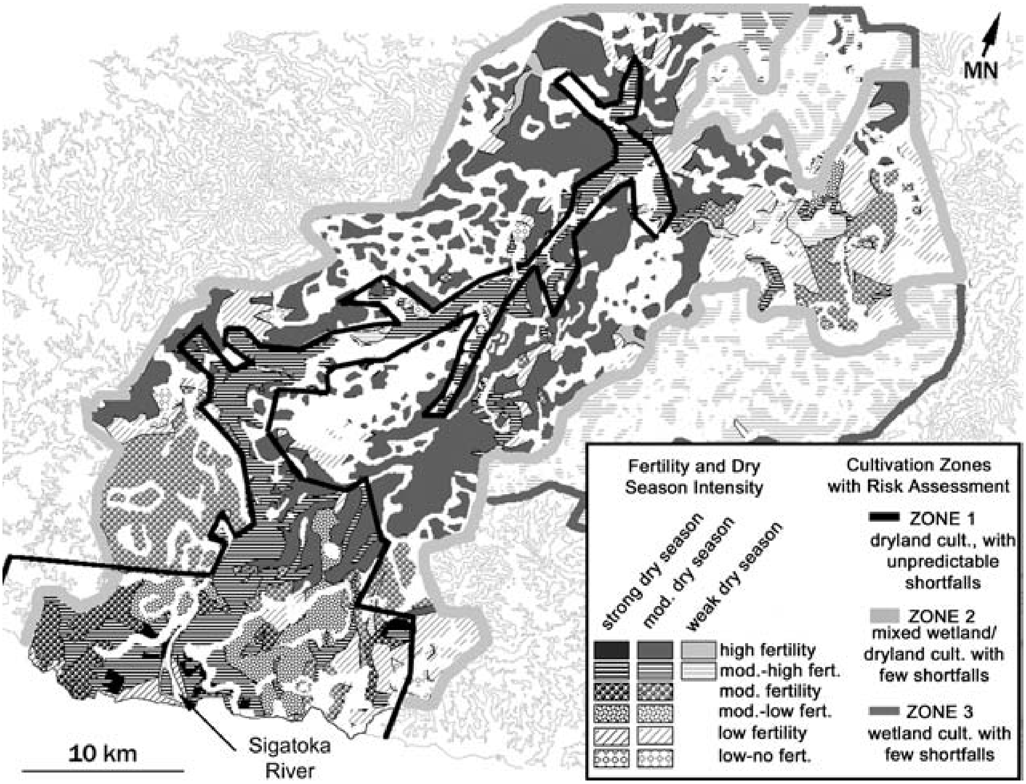

Figure 2. Extent of soils according to topography, fertility and intensity of dry season. Only soils on slopes of less than 45° are visible, and shown as either shading or patterning. Extents of cultivation Zones 1, 2 and 3 are indicated by enclosing lines.

from unpredictable shortfalls, and this may have had disastrous consequences from time to time. Thus, it is expected that there would be less extensive territories in Zone 1, and more evidence for conflict.

In most cases, the type and density of archaeological features that can be linked to conflict (e.g. fortifications, weapons or evidence for trauma in skeletal populations) provide an index for the level of disturbance in an area (e.g. Lambert 1994). It is important to note, however, that tracking areas of conflict is problematic for archaeology, as the coarseness of environmental and archaeological data rarely allows for the analysis of discrete events. Thus, identifying the frequency of competition and conflict in each zone and its impact upon the history of the region requires the analysis of alternative modes of information.

Historic land tenure

Historic land tenure data have the potential to highlight the more ephemeral traces of competition and territoriality. Research of agricultural field systems in Hawai'i has demonstrated linkages between intensification and environmental conditions, and also allowed for the mapping of demographic growth and systems of tribute relating to the activities of local chiefs (Ladefoged & Graves 2000; Ladefoged *et al.* 1996). In the case of

Fijian land-tenure, the size and distribution of specific groups (e.g. *yavusa* and *mataqali*) imply instances of conflict and conquest that resulted in the dispersal of populations to remote regions. In modern Fiji, economic and social relations are often conditioned by membership in two hierarchical levels of patrilineal relations—the *yavusa*, or ancestral lineage, and the *mataqali*, the family lineage. In the standard model, the *yavusa* consists of several *mataqali*, which are descendents of the original *yavusa* founder. Additionally, within each *mataqali* are smaller social units, called either *mbito* or *itokatoka*, which consist of closely related families who acknowledge the same relative as their head (Nayacakalou 1955). Anthropological literature designates these kinship configurations as 'unilineal descent groups', as they trace all ancestry through a single parent lineage. Nayacakalou (1955), Parry (1977) and Belshaw (1964) indicate that this kinship system has a direct relevance to land occupancy and tenure, as the structure of the system mandates that land is passed down through the male line, and the title remains under the control of the *mataqali*.

Nayacakalou states that from the Fijian perspective, socio-political organization is primarily a territorial conception, in which assemblages of *itokatoka, mataqali* and *yavusa* are associated with particular households within a village (Nayacakalou 1975: 22). Local associations of land-holding groups known as *vanua* (which include several villages and land-holders from all levels of descent) are perhaps the more cohesive territorial units, and the key to understanding traditional social structure and interaction. Fundamentally, *vanua* are associations of villages, and their boundaries are determined by land-ownership. When viewed in tandem with the *yavusa-mataqali* levels of land-ownership, *vanua* may provide the strongest indicators of the extent and character of ancient social units. This is due to the fact that these units are territory-based, and can remain stable despite the shifting associated with membership changes in the *mataqali-yavusa* system. Co-operation would have been more frequent amongst *mataqali* of the same *yavusa*, as these people would have regarded themselves as related and shared feelings of obligation and reciprocity. In addition, the extent of *vanua* territories should reveal the extent of *yavusa* alliances and confederacies.

Anthropological studies suggest that unilineal descent systems offer one of the most temporally stable organisations in human societies, and they persist in situations in which family groups are engaged in a form of group property or obligation, such as ownership of indivisible land, the construction and maintenance of agricultural systems, village-wide defences, or service in a particular organisation (Fox 1967; Holy 1996). In the case of Fijian land tenure, the descent group is the primary claimant for all properties, but networks of social obligations or duties relating to land-tenure may be more persistent at the level of the *vanua*. This point suggests that the extent of land-claims by unilineal descent groups and *vanua* are in some ways indicative of the history (in terms of geographic distribution and demographic growth) of particular lineages and confederacies. In particular, the configuration of land-claims in space may divulge the impact of competitive and co-operative strategies on prehistoric populations, and perhaps trace the character and frequency of interaction in the past. Land tenure patterns, in particular the size and distribution of parcels, may also provide an indication of the growth of populations, and their relative success as a territorial entity on the landscape. Although these data cannot provide a complete summary of the proceeding centuries, they can indicate the extent of expansion and movement between competing social groups.

Land tenure in the Sigatoka valley

The first documentation of patrilineal descent groups in the Sigatoka valley occurred in the years following the Little War (1876), when troops representing the new Colonial government were sent to the region to quell an emerging rebellion (Gordon 1879). Native land claims were recorded 40 years later (1912-16) when the Native Lands Commission funded a series of surveys in the Sigatoka valley (Figure 1C). The resulting maps and their indices detail the holdings of particular families, and most significantly, their membership within particular *mataqali, yavusa* and *vanua.* Using a digitiser and the analytic capabilities of a GIS, the enormous quantity of data provided by the Native Lands Commission maps were transformed into a single digital representation, using the parcels owned by particular families or *mataqali* as the fundamental units. This process revealed that by 1912 the Sigatoka valley was divided into 379 parcels. One hundred and twenty-three *mataqali*, which were members of 66 *yavusa*, were recorded as the land-owners, and these owners were assembled into 23 *vanua*. The GIS database allowed for the analysis of the spatial distribution of land-claims at all levels of ownership, and also compared their total area, degree of clustering and spatial configuration across the landscape. Additional analyses, including the co-occurrence of land-claims with particular archaeological sites, zones of agricultural production and mountainous areas were also compared and analysed within a GIS framework.

In general, the lands held by particular *mataqali* are widely distributed, endowing the map with an intense ‘patchwork’ quality (Figure 3A). However, when the extent of land-holdings at the level of the *yavusa* (the higher level of the kinship hierarchy) is displayed, more clustering is noticeable (Figure 3B). This is to be expected, as all *yavusa* subsume the parcels of the *mataqali* within their own confines. However, there are many instances where lands held by *yavusa* (thus, the *yavusa* members themselves) are scattered across the landscape. Figure 3C reveals the extent of *vanua* affiliation. For the most part these units are composed of contiguous parcels, although there are some dispersed units in the delta region. In general, *vanua* are more extensive in the upper parts of the valley, and also tend to run across more geographical features (e.g. the Sigatoka river and major tributary courses).

Nearest neighbour analysis (in this case using the program Crimestat II) provided an indication of the degree of dispersal amongst *yavusa*-owned properties. The distances between the centre points of each *yavusa*’s land parcels were assessed for significance and provided an index of how clustered (or how dispersed) they were. Assemblages of parcels that returned a NNa index value of less than 1.0 were classified as highly clustered; while assemblages that returned a NNa index of 1.0 were classified as moderately clustered, as this value typically suggests a random distribution which may or may not be due to clustering. Parcels that returned a NNa index value greater than 1.0 were classified as dispersed. The result (Figure 4) reveals that some patrilineal descent groups owned parcels of land that were clustered closely together at both the *mataqali* and *yavusa* level. Twenty-two *yavusa* (33 per cent) held parcels of land that were highly clustered. On average, clustering was highest amongst parcels owned by *yavusa* in the middle and upper reaches of the Sigatoka valley, and these parcels were also significantly larger than parcels in the delta region. Only 11 *yavusa* (17 per cent) held lands that were significantly dispersed, and this appears to

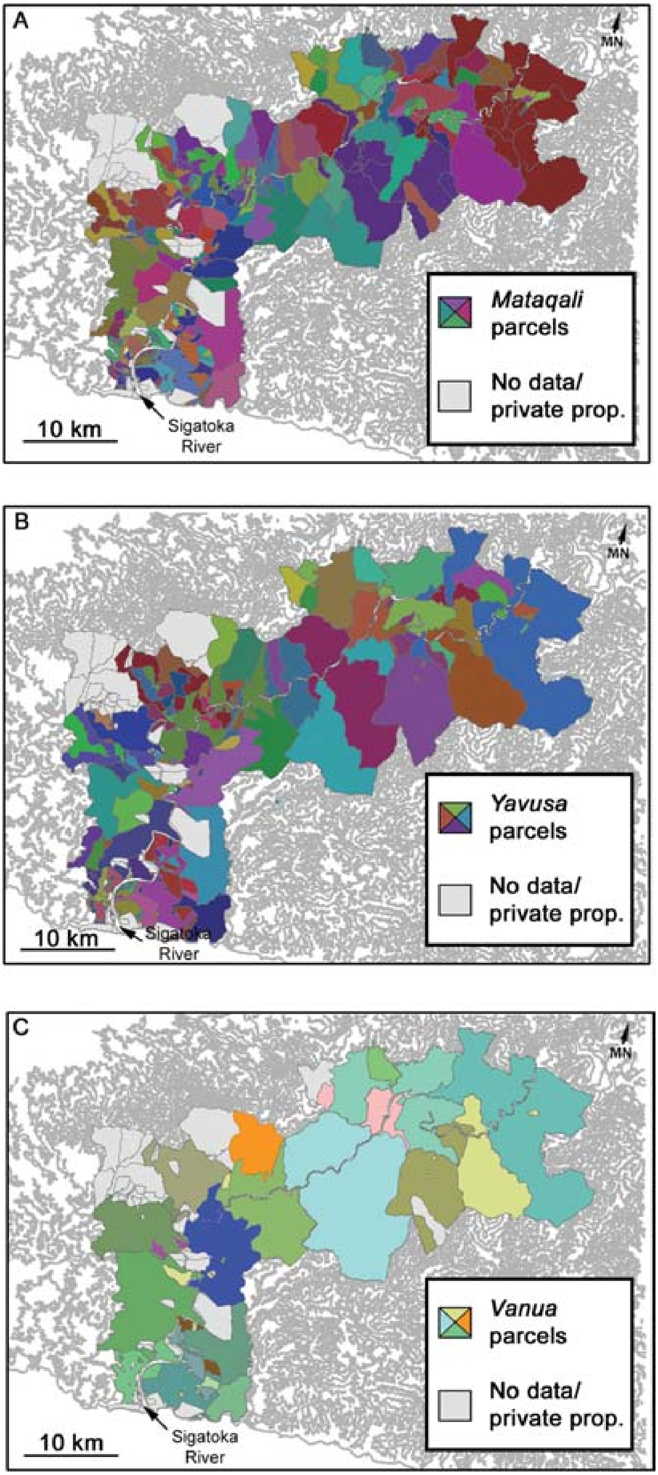

Figure 3. Distribution of land tenure claims in the Sigatoka valley. A) parcels at the level of mataqali; B) parcels at the level of yavusa and C) parcels at the level of vanua.

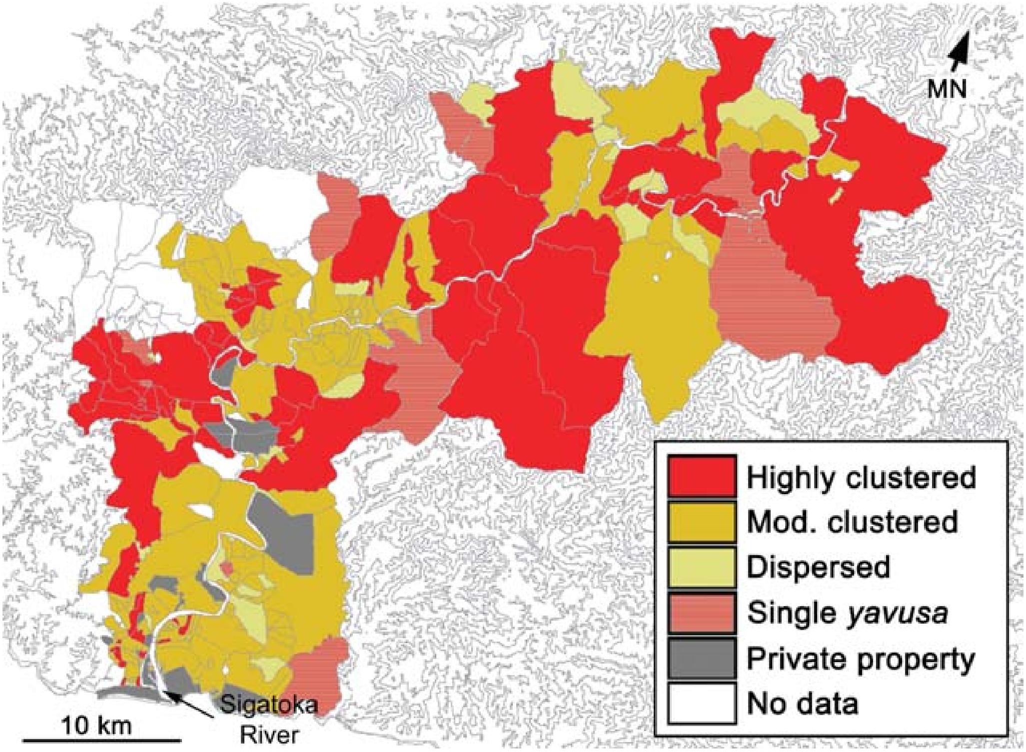

Figure 4. The degree of clustering of land-claims at the level of yavusa. Yavusa that claim only a single parcel are indicated by the striped patterning.

have occurred amongst moderate-to-small sized *yavusa* that were scattered throughout the valley.

Comparing the boundaries of the *yavusa* and the *yavusa* clusters with those of the ecological zones 1, 2 and 3 (Figure 5) strongly suggests that parcel size and *yavusa* dispersal is correlated with long-term trends in environmental variability. Most notable is the distribution of small parcels within the confines of Zone 1. This zone is a region of extensive yet seasonal productivity (e.g. expansive alluvial deposits suited for the seasonal cultivation of *uvi*), and also a region that was unpredictable due to episodic droughts. From the perspective of evolutionary ecology, Zone 1 may represent an environment that attracted occupation by many *yavusa*, resulting at times in a densely populated agricultural landscape. In addition, inter-*yavusa* conflict would have increased in response to unpredictable periods of drought or flooding, and escalated to long distance raids, conquests and migrations following the more lengthy or severe periods of shortfall. Based on these qualities, it seems likely that *yavusa* dispersal and small parcel sizes in this region resulted from multiple episodes of migration and fission that scattered the various branches of *yavusa* across the landscape.

Some support for this model can be found in oral histories of the Sigatoka valley, which describe a tradition of expansive conquest in the delta led by a succession of chiefs that sought (with limited success) to claim territory along the adjacent coasts (Nadalo 1957). The Namataku people from Bā were said to have invaded the Sigatoka valley in *c*. AD

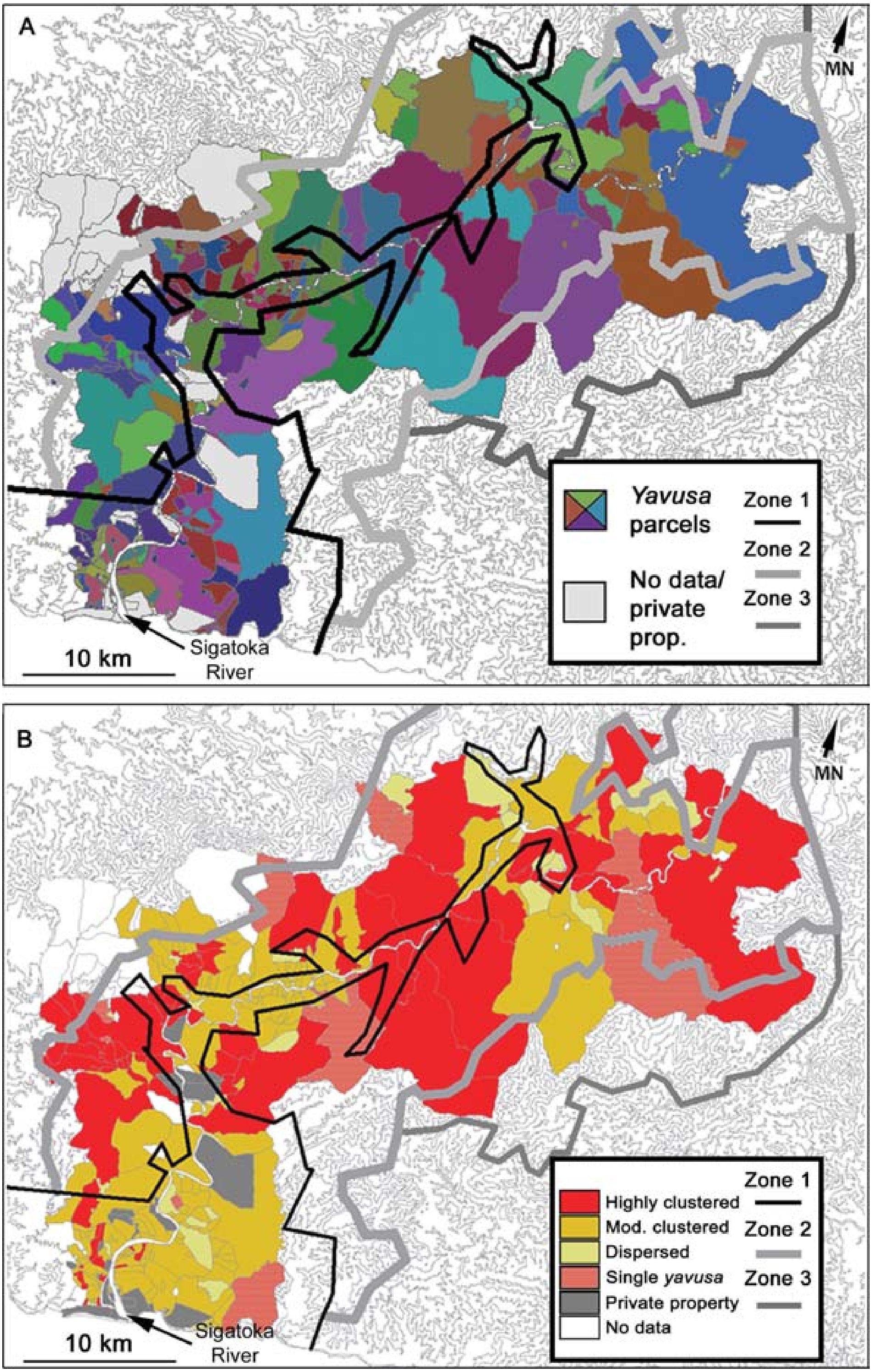

Figure 5. Comparison of yavusa and yavusa clustering with environmental zones 1-3.

1500-1650, and eventually gained control of the best agricultural land in the upper valley (Palmer *et al.* 1972). Similar strategies of expansionist colonisation have also been described for some Tongan, Rotuman and Hawaiian chiefs, whose lands were also limited in size and quality (Aswani & Graves 1998; Kirch 1984, 1994; Ladefoged 1993). The activities of these chiefs could be explained as attempts to maximise individual benefits, and also redirect competition from related rivals (i.e. junior chiefs or relatives with similar claims to chiefly titles) towards others (Boone 1983). The process of raiding and conquest may explain the general decline in *vanua* size in the lower valley (Zone 1) as well; as land-tenure shifted between feuding chiefs, the boundaries that constituted particular *vanua* were segmented into smaller units.

In contrast, no such tradition of chiefly expansion native to the upper valley (Zone 3, and portions of Zone 2 north of the delta) has been documented in oral histories, and *vanua* are much more expansive in these areas. Zones 2 and 3 encompass rugged lands with lower frequencies of environmental fluctuations, and contain a higher proportion of densely clustered *yavusa*, and also much larger parcels. The upper portions of Zone 2 also contain the highest concentrations of irrigated terraces used for cultivating *dalo*; roughly 38 per cent of all *dalo* terraces occur in this region (Field 2002: 102). The stability of the environment, as well as its suitability for the cultivation of this dense and predictable resource, probably allowed the *yavusa* and *vanua* of these regions to maintain territories with contiguous parcel boundaries. Co-operative strategies at the level of the *mataqali* (e.g. food sharing, or work groups associated with intensive agriculture) are also expected to have occurred with more frequency in this region, as the clustered nature of land-claims suggests that neighbours were often related to one another. In addition, the size of parcels within Zones 2 and 3 suggests that the inhabitants of these areas were more successful at controlling large areas, and did not have to rely upon offensive conquest to gain land for new lineage members.

Land tenure and fortified sites

Analysis of aerial photographs from the Sigatoka valley has documented the existence of 384 fortified and non-fortified ancient habitations across its varied topography, as well as over 200 agricultural features (Field 2002; Parry 1987). Using this information, approximately 1300km^2 of the valley drainage was analysed using 158 black and white aerial photographs on a scale of 1:16 000. Habitation sites were identified by the presence of cultural features such as mounds, ditches and raised terraces. The character and location of sites were then plotted into the GIS and compared with the surrounding terrain, environment and agricultural features in order to determine potential site function (see Field 2002: 109). Based on these criteria, habitation sites were divided into three classes: sites that had no access to resources and which exhibit a purely defensive or refuge strategy (*defensive sites*), sites in close proximity to agricultural resources and which also employ natural topographic or constructed defences (*defended production sites*), and sites located in prime agricultural areas without any form of natural or constructed fortification (*production sites*). Figure 6A illustrates the distribution of the habitation sites across the topography of the Sigatoka valley, and also shows their locations within the boundaries of environmental Zones 1, 2 and 3. Sites of each type exhibit some clustering along the valley bottom. Habitations that were purely

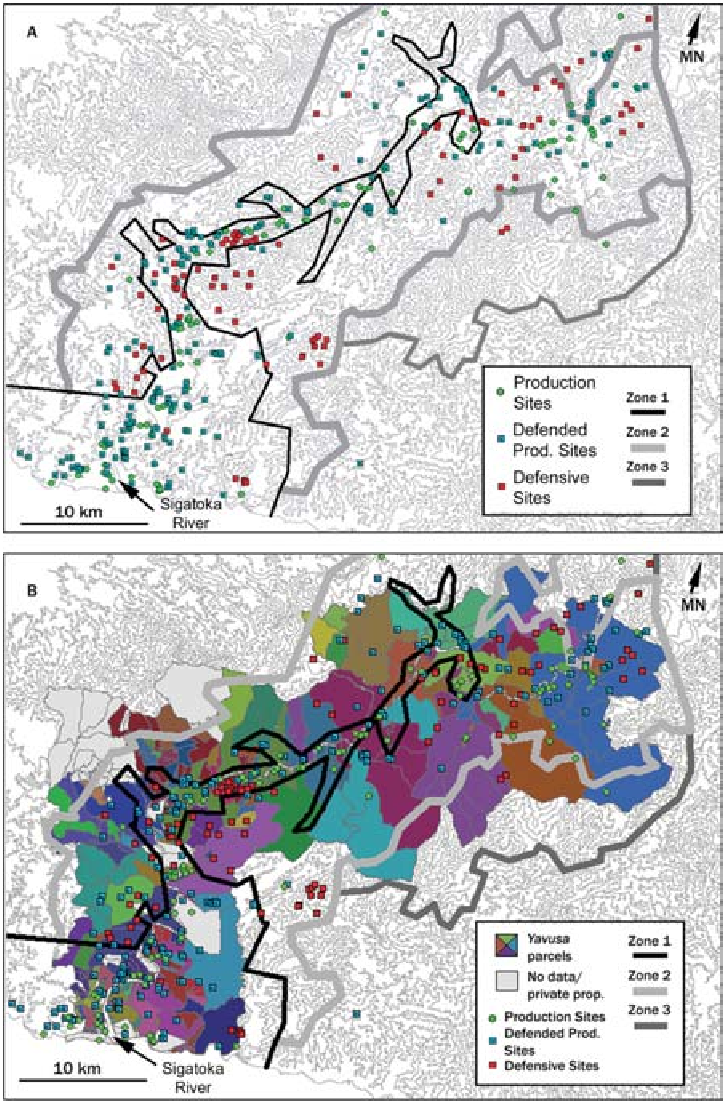

Figure 6. A) The distribution of production defended production and defensive sites in the Sigatoka valley. B) The distribution of yavusa-level land tenure with the location of production, defended production and defensive sites.

defensive in function were common in Zone 2. The lack of water and arable land strongly suggests that these habitations represent a defensive refuge strategy, in which inhabitants of the valley bottom maintained a distant stronghold for use during times of intense conflict or environmental disturbance. In contrast, the bulk of the defended production sites are located in Zone 1, and these represent a territorial strategy in which habitations were fortified with constructions or utilised a natural topographic feature that was in close proximity to arable land. The great numbers of these sites in Zone 1 reflect a need for a permanent occupation in an unpredictable environment, as a well-defended habitation ensured that populations could not be driven out of the area by raiding. Least common were the production sites, which were unfortified and located amongst the richest production areas of Zone 1. These sites may have been established as expedient villages associated with large fortifications nearby.

Figure 6B overlays the distribution of *yavusa*-level land tenure with the location of production, defended production and defensive sites. The greatest density of sites, in particular the defended production sites, occurs along the valley bottom amongst *yavusa* that are dispersed. In the context of land-tenure, defended production and production sites occur most commonly amongst the smaller-sized parcels (averaging 353 hectares), and also at the lower elevations. In contrast, purely defensive fortifications and refuges are located atop mountain peaks and ridges of large-sized parcels, averaging 528 hectares.

These distributions suggest that fortifications in close proximity to agricultural resources provided the main mode of habitation for Sigatoka valley populations, and site density was roughly correlated to population size and also the extent of land claims amongst *yavusa*. Thus, most populations constructed several habitations across the extent of their land holdings, and in most cases the total number of sites increased in accordance with the extent of territorial boundaries. The distribution of production, defended production and refuge-focused sites reflect a universal need for subsistence proximity and security for all the Sigatoka valley populations. *Vanua* show a similar positive trend in size and total site number, although several are exceptionally large in size and contain an equivalent number of additional fortifications. The distribution pattern does not indicate that any one *vanua* contained considerably more or less fortifications across its territory.

Discussion

Small parcel sizes, *yavusa* dispersal and the prevalence of defended production sites indicate that land tenure in Zone 1 was the most crucial to subsistence, and also the most disputed. These findings concur with the evolutionary ecology predictions outlined in the introduction: resource distribution influences territoriality. However, the addition of unpredictable environmental fluctuations over time encourages the escalation of competitive strategies, in particular direct aggression and defensiveness. In the Sigatoka valley case, disparities appear to have fostered raiding and group fission, resulting in populations occupying defensible habitations in the valley bottom as well as maintaining distant refuges in the mountains. The extent of large *yavusa* parcels and clusters in the northern portions of Zones 2 and 3 suggests that the stability of the environment in these areas allowed for reduced rates of raiding and fission. The clustering of closely related populations also suggests that co-operative strategies occurred more frequently in the upper valley.

In terms of Fijian prehistory, the results uphold the conclusion made by early anthropologists that the 'patchwork' quality of Fijian patrilineal descent groups is a product of centuries of fission, migration and alliance, and that fortifications and competition were essential elements of prehistoric society. They also identify some of the factors that led to this condition, and in light of archaeological research that suggests the presence of fortifications as early as 1500-1000 BP, these results also suggest how competition and conflict could have developed prior to the growth of large populations.

Studies of fortifications and environmental variables from around the world have demonstrated a close relationship between territoriality and subsistence in prehistory.

Analyses that combine land tenure data with environmental and archaeological information are beneficial in that they provide a glimpse of the end-results of territoriality. Although the configuration of populations in the latest prehistoric periods cannot be assumed to reflect all previous interactions, in the case of unilineal descent groups they can provide an index for the relative frequency of social division and integration that occurred in the past.

Acknowledgements

Funding for this research was provided by the National Science Foundation (Dissertation Improvement Grant # BCS-0106221), the University of Hawai'i Space Grant College (Fellowship 1997-1998) and the Honolulu Branch of the American Association of University Women (Pacific Fellowship 2001). Special thanks go to the Fiji Museum, especially Sepeti Matararaba and Jone Naucabalavu. I am grateful to Michael Graves, Thegn Ladefoged, Martin Carver and Tim Thomas for their commentary and insight.

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