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Geomorphic and archaeological consequences of human arrival and agricultural expansion on Pacific islands: A reconsideration after 30 years of debate

Matthew Spriggs

School of Archaeology and Anthropology, Australian National University, Canberra, Australia
Matthew.Spriggs@anu.edu.au

Introduction: The distorted history of an idea

The late 1970s was an exciting time to be a PhD student in archaeology at the ANU, with many new ideas flying around and being discussed by staff and students, usually over a beverage or two or three at the ANU Staff Club. Prominent among sometimes-heated discussions were those pertaining to human-environment relations. The dominant paradigm up to that time in the Pacific was a fairly pedestrian environmental determinism, with prehistoric humans having had very little agency (although at the time we did not use, indeed did not know the word in such a context: see Dobres and Robb 1999). Humanly induced, or at least humanly accelerated, landscape change was the latest idea, and the ferment of a paradigm shift was everywhere. Geoff Hope was one of the prominent exponents of the new ideas in those discussions. He and others of like mind were key influences on my thinking as I embarked on PhD fieldwork on the island of Aneityum in southern Vanuatu in mid-1978 (Spriggs 1981).

This time and these intellectual influences are worth reflecting on, as some recent discussions of the history of debate over human-environment relations in the Pacific seriously misrepresent that history. If we are to believe Patrick Nunn, for instance, the 'orthodoxy' among Pacific archaeologists has *always* been (and indeed remains today) that human acts have shaped Pacific environments to the exclusion of natural factors (Nunn 1991, 2001, 2003, 2007:169-71; cf. Kumar et al. 2006:141). To the contrary, during the period in question, the orthodoxy was the opposite to that portrayed by Nunn, and we felt that a battle needed to be fought to establish some human involvement in the story of Pacific environmental change.
Kirch (1997a:3-11) provides a very useful potted history of the issue of humans and their place in island ecosystems (cf. Fosberg 1963), in an edited volume (Kirch and Hunt 1997) that represented the first wide-ranging synthesis exploring pre-industrial human impacts on

Pacific environments. Kirch's story starts with Louis-Antoine de Bougainville arriving in Tahiti in 1769, himself influenced by the 'homme naturel' views of Rousseau. The 'noble savage' trope long held sway until some time after World War II, with only a few early dissenters who saw some reciprocal human influence on the environment of the islands.

The development of the 'New Archaeology' in the United States and parallel developments in the United Kingdom by the late 1960s, with their ecologically based frameworks, led to a change in view among Pacific archaeologists. The general recognition of the role of humans in environmental change in the region only occurred in the mid- to late-1970s as archaeologists and natural scientists began to work together at institutions in places such as Hawaii and Canberra. In 1997, Kirch specifically questioned Nunn's 'curious, and to our mind unfounded, assertion that most writers have attributed environmental change on Pacific islands to human impact' (Kirch 1997a:15, referencing Nunn 1991). Nunn (2003) acknowledges but clearly fails to understand Kirch's point here.

It should be noted that none of the proponents of the argument for an important role for human-induced erosion in Pacific landscape evolution argued that all prehistoric environmental change was human-induced. For example, the interplay of human actions and natural cyclonic and other high-rainfall events was discussed, and major earthquake activity also canvassed, as being significant erosional agents on Aneityum (Spriggs 1981). The differences in landscape susceptibility to erosion between the wetter windward and drier leeward sides of islands were also noted, with the latter seen as far more vulnerable to disturbance (Spriggs 1981: Chapter 5, cf. Spriggs 1985). It was particularly the interplay between human interference with the vegetation and natural catastrophic events that was highlighted.

The 'Spriggs hypothesis'

My 1981 PhD postulated a series of three linked propositions relating to Pacific environmental change. The first, not at all original but crucial to the other two, was that much of the mid to late-Holocene landscape change on Pacific Islands was humanly accelerated, if not humanly induced (Proposition 1). Two further propositions – labelled by the late Roger Green, one of the thesis examiners, the 'Spriggs hypothesis' – developed from this. Proposition 2 was that in certain geological circumstances the effects of such prehistoric landscape changes would make it very difficult for archaeologists to find early cultural sites on volcanic islands, as they would be deeply buried by the products of erosion. This was used to explain putative gaps in Lapita site distribution on many larger Melanesian islands, such as the Solomon Islands chain and in southern Vanuatu. Proposition 3 was that the effects of such early humanly accelerated erosion were beneficial to human settlement on the islands in the medium to long term, by creating large coastal plains where much of the population currently lives. Previously, terms such as 'degradation' had been used to describe such human impacts (as in Hughes et al. 1979). A more tentative corollary was suggested, that at least in some cases the erosion was intentionally induced (Proposition 3a).

A fourth proposition was added post-thesis, that the initial response to (in the short-term sometimes disastrous) humanly accelerated erosion was to move settlement to another area. As Pacific populations grew, this response was no longer possible. Reanalysis of the original Aneityum results suggested a pattern of significant human environmental impacts immediately after initial settlement, followed by a hiatus of several hundred years in occupation or use at particular locations. When use of an area began again, usually for gardening, it was seemingly continuous to the present (Spriggs 1997). Similar findings were being published in the 1980s and early 1990s from other islands such as East Futuna (Frimigacci 1990) and O'ahu, Hawaii (Allen et al. 1987). These suggested a more general model.

Initially, in a land-rich situation with low population densities, conservation measures such as terracing were not considered necessary. Any perceived environmental degradation in the short-term could be alleviated by moving to another valley or even another island. Later, in land-full conditions, this option was not possible. In addition, with larger populations than were present at the earliest stages of settlement, considerable investment in capital works such as soil-retention terraces and storm drains could be undertaken. When catastrophic erosion buried irrigation systems, they were immediately rebuilt (Spriggs 1997:97-98).

A corollary of this model is that conservation measures associated with more intensive agricultural practices developed over time on islands in response to changing subsistence and social demands. People could indeed learn from their earlier mistakes. The investment in erosion-control measures both allowed, and to some extent required, permanent occupation of the affected lands. Indeed, requirements for the maintenance of such capital works may have essentially 'tethered' people to them. The rest of the paper examines how these four linked propositions have stood the test of time since those heady days at the ANU in the late 1970s.

Proposition 1: Human-accelerated landscape change

In the late 1970s, the general view around the ANU among archaeologists and natural scientists was that there were no significant effects in Australia or the Pacific Islands of the Little Ice Age (LIA) and other postulated late-Holocene climatic changes. This again was in reaction to earlier geomorphological thought where minor climatic variations were used to explain any evidence for Holocene deposition of extensive areas of alluvium.

This earlier view had been criticised by Butzer (1974) in relation to the Mediterranean and, closer to home, by Hughes and Sullivan (1981) in relation to alluvial sequences in New South Wales. Noting the lack of correlation between the dating of the postulated climatic changes and sequences of valley fill, they suggested that Aboriginal burning patterns removed leaf litter more frequently than would have happened by natural bushfires and over a longer period of the year. This increased the susceptibility of the soil to rain-splash erosion and led to accelerated erosion. In my thesis, I concluded: 'It is not clear how minor climatic changes could have so altered an established vegetation cover as to lead to the greatly accelerated erosion and valley infilling which have been the object of investigation' (1981:97).

Subsequently, evidence has been marshalled – particularly, but by no means exclusively, by Nunn (1997) – to suggest much greater environmental instability as a result of climatic perturbations affecting our region. We are now in a much better position to evaluate this idea than we would have been in the late 1970s and 1980s. Nunn's main contention seems to be that it was not so much the LIA itself, but the 'AD 1300 event', a period of very rapid climate change marking its start, which led to major landscape instability (Nunn et al. 2007). The supposed effects include a sea-level fall of at least 0.8 m that exposed and killed reefs, and lowered water tables all over the islands, which thus affected agricultural productivity and caused stream incision, which in turn caused slope instability and erosion. This was associated with a sudden cooling and increased storminess.

Nunn claims the AD 1300 event resulted in a catastrophic food crisis for Pacific Island communities, with food resources falling 'by around 80%' (Nunn 2003:224). The human response was suggested to be a move into marginal and inland areas away from the coast, first occupation of many smaller islands, abandonment of other isolated small islands, changes in resource exploitation, reduced interaction between communities except for warfare and cannibalism, the end of long-distance voyaging across the Pacific, the end of pottery making in some areas, the appearance of new belief systems, the construction of megalithic monuments and localised pig extirpation (Nunn 2007: Chapter 6).

If such an event did occur, and if such human responses were indeed linked to it, then it would indeed have been a major period of cultural change in the Pacific. But on every point, from cooling to sea-level change to resource depletion, Nunn's assertions can be challenged.

Allen (2006) answers most of Nunn's assertions decisively, indeed devastatingly. Using recent palaeoclimatic data from the region itself, she shows that the previous Medieval Warm Period (MWP) was a time of colder weather in the equatorial Pacific, while the LIA was warmer - the opposite of the Northern Hemisphere-derived model Nunn is using to underpin his views. Changes there may have been, but there is little to suggest they were as abrupt and of such magnitude. On Nunn's own reading of the preceding MWP period, there were times within it of quite extreme climatic change. This implies that people had long been exposed to sudden changes in climate before any 'event' such as that postulated by Nunn. Suitable responses, therefore, may have already been developed for such eventualities. If a 1300 AD 'event' did occur, it was not a one-off. The sea-level data on which much of the model is based have also been questioned. Gehrels (2001), for instance, points out that the suggested relationship between sea level and climate is compromised by height uncertainties and dating problems, including Nunn's (1998) failure to use calibrated (calendar) radiocarbon dates.

Climatic instability does need to be added into the mix in regards to the degree of humanly accelerated landscape change that has occurred in the region during human occupation. For instance, in the past decade, attention has been drawn to changing cyclone frequencies in particular areas. These variations relate to ENSO cycles and are seen as significant in 'forcing' cultural change (Anderson et al. 2006). Humanly accelerated or induced erosion must always be considered within the context of other significant processes causing slope instability, such as climatic changes leading to altered cyclone frequency, earthquakes leading to uplift or subsidence, and deposition of volcanic ash changing slope susceptibility to catastrophic landslides. But even after these factors are taken into account, it seems absurd to deny that humans, by vegetation clearance for agriculture and other purposes, have had a major effect on the landscape of Pacific islands. To do so is to deny them agency, the ability to act on the land and shape it – for good or ill. Instead, they are seen as passive victims of climatic change, their existence always completely subject to the perturbations of nature they can have no control over and no power to ameliorate. The evidence remains overwhelmingly to the contrary (see below, Proposition 3a).

Propositon 2: Difficulty of finding early sites

The Southern Vanuatu Culture History Project was begun in 1983 specifically to test the idea that humanly accelerated landscape change was affecting early site visibility. The project concentrated on the island of Erromango, where it was predicted that early pottery-bearing sites would be easily located, adjacent to stream mouths on the island and protected from deep alluvial burial by the raised limestone terrace fringe of an otherwise volcanic island (Spriggs and Wickler 1989). The Imponkor limestone formation along the eastern side of the island was targeted, an extensive area of recent raised reef about 2-7 m above sea level (Colley and Ash 1971:48-49). As the formation was backed by older reef terraces, depositional conditions were therefore analogous to those expected to obtain on low coralline islands where site visibility is high and where it had been argued that Lapita sites were preferentially located (Green 1979:32).

Pottery was found at Naen near Ipota along the Imponkor limestone belt, and excavation further south again at Ifo revealed dentate-stamped Lapita pottery (Spriggs and Wickler 1989). This provided strong evidence against the idea that Lapita people preferred low coralline islands for their settlements. This apparent pattern was an artefact of post-depositional changes

reducing site visibility on larger volcanic islands. Early sites were thus likely to be deeply buried by the products of erosion. It was a significant issue at the time because Bellwood (1978:262, 264) and Green (1979:47-48) had previously argued for a pre-Lapita occupation of Remote Oceania (specifically Vanuatu and New Caledonia), partly on the basis of the supposedly aceramic nature of the southern Vanuatu archaeological record (see Spriggs 1984 for discussion). Further development of this project was cut short by the general research ban applied by the Vanuatu government in 1985, which lasted for a decade.

Green (1985) was an early commentator on Proposition 2, finding it much more persuasive for areas in Remote Oceania where Lapita is likely to be the founding culture. He noted that the old idea that Lapita sites were found more generally in marginal locations on small islands offshore of islands which already had a population had not entirely stood the test of time, even without the 'alluvial hypothesis'. But this did not stop him from invoking just such a possibility for Near Oceania. He maintained that this was still a viable alternative to the proposition that if there are sites in such marginal locations, then there must be many more on the main islands.

This proposition is still very much contested and is especially pertinent to current debates about Lapita site distribution (or rather the gaps in it) across much of the main Solomons chain. Sheppard and Walter (2006, 2009), supporting Green (1985), would see the lack of Lapita sites as a real absence rather than a sampling problem as would be argued from Proposition 2. They were responding in this instance, however, to the arguments of Felgate (2003, cf. 2007), who has raised the problem of sea-level change obscuring the presence of what were originally stilt-house village sites in the nearshore sub-tidal zone of many islands. Felgate's argument was not so much that early sites were deeply buried, but instead that they were located offshore and so archaeologists had been looking in the wrong places for them, needing to get their feet wet and wade out on to the reefs or even don snorkel and mask to explore the deeper depths.

Such a finding had originally been reported by Stephen Wickler, researching Lapita sites on the island of Buka and adjacent smaller islands (Wickler 1995, 2001a). A recreational wander over the reef at Kessa Plantation had revealed Lapita pottery scattered across and indeed embedded into the reef. His subsequent work on Sohano Island just off Buka revealed similar sites. Lapita stilt-house villages were already known as a site type in the Bismarck archipelago, but 3000 years of coastal progradation had covered up their remains. This meant that excavation of them in 1985, as part of the Lapita Homeland Project (Allen and Gosden 1991), was conducted from what is now dry land (Gosden and Webb 1994; Kirch 1987, 1988a).

Others have now entered the debate. Clark and Bedford (2008:59) use the ecological concept of 'friction zones', landscapes that are 'hostile, fragmented, unfamiliar or difficult to reach' and so are avoided by early colonists. Their study of apparent 'friction zones' within the overall Lapita distribution concluded that an avoidance of the main Solomons chain by early Lapita colonists would be extremely unlikely. Most recently, a linguist, Andy Pawley, has weighed in on the debate (Pawley 2009). His conclusion is that for the northwest Solomons the leap-frog model of Sheppard and Walter could explain the linguistic situation. But it is unlikely on linguistic grounds that the rest of the main Solomons from Guadalcanal to Makira remained empty of Austronesian speakers until 2300-2000 BP. We should expect to find early Lapita sites therefore at points across that region. The problem is thus sampling, and a likely cause of difficulty finding such sites is post-Lapita landscape change on these high volcanic islands.

Systematic research recommenced in Vanuatu in 1994, immediately after the 1985 research ban had been lifted. It has shown that burial by volcanic ash of early sites on many islands in that archipelago is perhaps a more significant factor in obscuring their location than burial by humanly accelerated erosion. Ironically, Aneityum and Erromango are among the few islands where recent volcanism has not had any significant effect in terms of tephra deposition. Early

sites on Efate and other central Vanuatu islands, Malakula, Ambae, parts of Santo, and on some of the Banks islands have all been located – sometimes with great difficulty because of depth of burial – beneath such volcanic deposits. The disadvantage of difficulty of site location is compensated for by the often exceptional preservation conditions that result from the sites being emplaced well below the 'plough zone' of traditional agriculture (see Bedford et al. 1998, 2006; Bedford and Spriggs 2000, 2008; Spriggs and Bedford 2001; Bedford 2006).

Human-accelerated erosion has also been blamed for the gaps in the distribution of other early settlement sites in the Western Pacific. Clark and Anderson (2001) invoke such an idea in relation to western Fiji, concluding: 'there is little reason to suspect that within the western group colonisation sites were preferentially distributed on islands adjacent to Viti Levu and Vanua Levu rather than on the major islands themselves' (Clark and Anderson 2001:81).

Kirch and colleagues provided a sophisticated model of landscape change for the Lapita-derived site of Toaga on Ofu in American Samoa, invoking both subsidence and sea-level fall after the mid-Holocene high stand, and slope instability caused by vegetation clearance as operative processes (Kirch and Hunt 1993). The site existed on what was initially a narrow coastal flat below a steep hillside. It was only found after a landfill site was gouged out of the present colluvial slopes of the area, revealing the deeply buried Lapita-derived early pottery site. In places, this is buried by up to 10-15 m of colluvium. Kirch and Hunt (1993:234-236) extend their model to suggest application not only elsewhere within American Samoa, but also in the search for early sites in the southern Cooks, the Australs and the Society Islands. Variants of the model have also been shown to have value for Mangaia in the Cooks (Kirch 1997b), Niuatoputapu in Tonga (Kirch 1988b) and more recently Palau (Wickler 2001b) – but see Dickinson and Athens (2007) for a useful corrective concerning the influence of subsidence for that last island group, perhaps also applicable to other cases.

Subsidence was also established as the reason for the lack of early Lapita sites in Western Samoa, where Dickinson and Green (1998) explained the occurrence of the only true Lapita site yet found in Samoa some 4 m below sea level under a later capping of coral reef growth. In this case, the serendipity of discovery was the need for a deep-water ferry terminal at Mulifanua, requiring a major dredging operation.

It is now clearer that multiple processes can affect site visibility, both natural – as with tephra deposition – and humanly accelerated. Conventional surface survey is unlikely to provide a full picture of Lapita site distribution in either case, and hypotheses based simply on apparent absence of sites, without due consideration of the geomorphological context, are constructed on weak foundations.

Proposition 3: The benefits of human-accelerated erosion

The major benefit was seen in the creation of large coastal plains where most of the population lives today. This is now so well accepted that it is often stated as a given. Leaving aside the cause of the creation of such plains for the moment, it is empirically easy to verify that this is indeed where much of the population lives today and that such areas are often, or were at least until recently, the site of major irrigation or other garden systems providing much of the vegetable produce for growing populations. Kirch (1997b) gives a particularly good illustration of such enhancement in the case of Mangaia in the Cook Islands.

Nunn (1991) has pointed out that in some cases the bedrock substrate for such plains is formed by reef deposits that were raised above sea level by either sea-level fall after the mid-Holocene high stand or by tectonic uplift. But the soil still had to come from somewhere, and natural erosion rates are arguably unlikely to have provided sufficient depth of material across these plains during the past 3000 years to make them productive.

The common presence of dispersed charcoal and sometimes significant charcoal lenses within the alluvial deposits that make up these plains instead suggests another cause: the instability generated by clearing vegetation from slopes upstream using fire, to establish gardens and for other clearance purposes. Natural fire is unlikely as the general explanation, given that fire is rare or absent from pre-human pollen cores in most areas of the tropical Pacific. Even where natural fire is recorded in such cores, there is a quantum increase with the arrival of humans – whether they arrived 3000 years ago or fewer than 1500 years ago. Hope et al. (1999) provide a good summary of examples of these phenomena.

A test of whether natural erosion rates could create these coastal plains is readily to hand. One could compare coastal-plain deposition rates for the past 3000 years on early-occupied islands in island Melanesia and Western Polynesia, with islands settled only 1500 or fewer years ago in Eastern Polynesia. To my knowledge, such a test has not been undertaken.

Propositon 3a: The intentionality issue

The somewhat tentative conclusion was made that, at least in some cases, the erosion leading to the development of such alluvial plains was intentionally induced. This implies strong human agency in the process, and a degree of control of the environment that is quite remarkable for pre-industrial or pre-urban civilisations. Nunn is sceptical, suggesting that 'such understanding of environmental management appears implausible' (Nunn 2003:222). It is, of course, extremely difficult to prove archaeologically.

This sort of control is attested ethnographically, but it could be argued that the evidence may represent influences from the colonial situation (cf. Spriggs 2008). Such influence is possible, for instance, in the practice of 'hydraulicking' to move sediment from one place to another in the construction of new rice terraces in the Ifugao region, as recorded in the later 20th century several hundred years after Spanish colonialism began in the Philippines (Conklin 1980:16-17, discussed in Spriggs 1997). But such an explanation would be more unlikely for the immediate post-contact period in the New Guinea Highlands. There, the directed use of water to erode soil as part of traditional mining operations was recorded at the Ganz-Tsenga stone-axe quarries: 'The quarry was in a clearing on the hillside, and a water race led to the top of it to wash away ground and expose the rocks' (Vial 1940:159). The deliberate and spectacular use of erosion, this time for not fully understood cultural reasons, was also recorded in a situation unlikely to be influenced by colonial practices in the Wantoat area of the Finisterre ranges. Ponds were constructed to hold large amounts of water above steep slopes. At a given sign, the sluices were opened all at the same time and the ensuing flood washed soil, rocks and trees downslope (Vial 1937; Schmitz 1963). The process of deliberately inducing erosion was clearly understood within the Pacific.

There are indeed several possible archaeological examples of the process. Hughes et al. (1979:109) suggested not only that the productive sub-coastal swamplands developed on Lakeba after human arrival as a result of vegetation clearance, but that their creation may have been actively encouraged by the people of the island. Deposition of soil, branches and tree trunks in valley bottoms, assisted by severe cyclones, choked valley outlets, and sediment-charged run-off was ponded behind such barriers to create swamps used for growing taro. Hope et al. (1999:396) have suggested that swamps in the upland area of Evoran in Erromango, Vanuatu, were purposely created by blocking a creek line with earthworks across a valley. A date of 2000 BP has been obtained for the creation of one of these ponds.

From the Keanae Peninsula on Maui comes what seems to be one of the most extreme forms of deliberate soil formation. What became productive irrigated taro lands was originally a barren lava flow. Oral tradition records that a chief, seeking to increase production in his

domain, set his people to work 'carrying soil in baskets from the valley down to the lava point. The soil and the banks enclosing the patches were thus, in the course of many years, all transplanted and packed into place' (Handy 1940:110). A quick look at the *Soil Survey of the Territory of Hawaii* maps and accompanying soil descriptions certainly does not rule out this possibility (Cline et al. 1955:347, 607); direct archaeological investigation would settle the matter.

By the time of European contact, the peoples of the Pacific were engaged in sophisticated landscape engineering involving construction of stone-faced terracing, artificial channelling of water through construction of canals, storm drains, stone-lined river channels and earthen aqueducts, large-scale bank and ditch construction for fortifications, and construction of temple platforms and stone sculptures, some of them involving the movement of stones weighing many tonnes (see Kirch 2000 for a summary). Some irrigation canals ran for several kilometres and crossed major watersheds (Spriggs 1990).

Given this sophisticated engineering knowledge, it seems clear that Pacific Islanders could also have known how to shape the landscape in other ways, through deliberately inducing erosion – indeed the New Guinea evidence would suggest they did possess such knowledge. Although perhaps impossible to prove archaeologically, such practices are certainly not beyond their known technological competence.

Proposition 4: A two-stage response to erosion damage

There was an initial response of abandoning the affected site and a later, land-full one of investment in erosion-control measures and rebuilding garden systems in place. The proposition does not seem to have received significant attention since its more explicit formulation in the 1990s. Testing it is extremely difficult with our current lack of understanding of changing settlement patterns in the Pacific and in particular the dearth of detailed agricultural sequences from many islands, particularly in the Western Pacific. Obtaining such understanding should be a priority for the future. There are few new sequences of agricultural change and development additional to those used originally in the formulation of the proposition for Western Polynesia and island Melanesia, where suitably long sequences can be expected – New Caledonia is a notable exception (Sand 1999, 2002; Carlson 2008). In Eastern Polynesia, much more detailed information is available; for instance, most recently for Maui and Hawai'i islands (Ladefoged and Graves 2000; Ladefoged et al. 2003; Kirch et al. 2004; Vitousek et al. 2004), Easter Island (Stevenson et al. 1999, 2006; Mieth and Bork 2005), and New Zealand (Barber 2004, and references therein). Initial settlement dates remain controversial, however, for many Eastern Polynesian archipelagos, making the definitive establishment of cultural sequences difficult (Spriggs In press). Given the probability of pre-European settlement sequences of fewer than 1000 years, the long-term sustainability of these particular agricultural systems cannot easily be assessed.

Palynology and related disciplines are providing further lines of evidence. These are tracking both general vegetation change and, in some cases, individual crop introductions and utilisation (examples include Hope 1996; MacPhail et al. 2001; Haberle 2003; Kennett et al. 2006; Horrocks and Wozniak 2008; Prebble and Dowe 2008; Prebble and Wilmshurst 2009). It would be a pity, however, if archaeologists working in Western Polynesia and island Melanesia were happy to leave the field to these other disciplines. Only archaeology can study the direct field remains of the agricultural systems and attendant erosion-control measures that constitute a large part of the human response to changing environmental conditions over 3000 or more years since first settlement.

Reliable dating of such systems remains a real problem. Another issue is clearly cost: the Hawaiian research constitutes a major interdisciplinary effort, requiring proportionate amounts of funding. Agricultural systems are often spatially extensive and can be stratigraphically complex and differentiated within even small areas. The investigation of swamp systems has its own problems, solved in the case of the Kuk site in the New Guinea Highlands by large-scale modern drainage to create a tea plantation (Golson 1977). Similar opportunities for investigation on this scale have not arisen since elsewhere in the Pacific.

Conclusions

Since first formulated, three of the four main propositions have held up under scrutiny to various degrees. In all cases, there have been supporters and sceptics, and the sceptics have been valuable in helping to give additional processes their proper due. Nunn's (1997) stressing of natural climatic changes has led to a healthy debate about the extent of prehistoric human impacts on Pacific landscapes. The extreme development of this, his AD 1300 'event' scenario, has its fans as well as its detractors. The detractors stress that the people of the Pacific were agents rather than victims of their fate on these scattered and vulnerable islands.

It now seems self-evident that the erosion that created the current coastal plains of the islands has been, in the medium term, beneficial to human existence on them rather than deleterious, whether it was humanly accelerated or largely climate driven – a question that still needs to be resolved through a comparison of early- and late-settled islands across the Pacific.

Proposition 4 on different early and later responses to major erosion episodes has not received as much attention as the others. It requires a greater understanding of settlement patterns and their changes over time than we currently possess, and a different scale of archaeology than is usually attempted in the Pacific Islands.

The most contentious of the propositions remains Proposition 2 about visibility of early sites being obscured by post-settlement landscape changes. It clearly has been demonstrated for some islands – those where often accidental processes have indeed revealed early sites deeply buried under alluvial or colluvial deposition. But its applicability where such sites have not (yet?) been found remains debated – the central Solomons are currently the main focus for such debate. A complicating factor not evident in the early 1980s is the degree of blanketing of landscapes by volcanic tephra deposits across large parts of Vanuatu and several other archipelagos. Subsidence is another factor affecting site visibility in some areas. Given the increasing pace of archaeological discovery of the past few decades, it would be a brave scholar indeed who would suggest that we have already found all there is to be found in this regard. Time will tell.

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