The value of historical ecology in planning for sustainable livelihoods

A Kiribati case study

Frank R. Thomas

Abstract

The precariousness of human existence on atolls, both past and present, is apparent when one examines the close linkages between communities and their environment. There have been few applications of Historical Ecology, the transdisciplinary study of how human societies and the ‘natural’ environment interact and transform each other through time, on atolls and other coral islands, particularly for the period preceding Western contact. Kiribati provides examples of communities that did not endure, as well as others that were sustainable for some 2,000 years. Knowledge of ecological complexity over centuries and millennia is a critical first step in the process of identifying the causes of environmental change and devising realistic methods for managing scarce atoll resources, as well as assessing the effectiveness of traditional adaption strategies in contemporary settings.
Historical ecology

By engaging with researchers in environmental history, ecology, geography and anthropology, environmental archaeologists have sought to develop the integrative field of historical ecology: the transdisciplinary study of how human societies and the ‘natural’ environment interact and transform each other through time (Balée, 1998; Crumley, 1994).

Several themes in historical ecology were explored in ‘high’ island contexts (Fitzpatrick & Keegan, 2007; Kirch & Hunt, 1997). Far less is known about atolls and table reefs. More specifically, little is known about palaeoclimatology, the introduction history of exotic fauna, the extent of human-induced environmental impacts, and social transformations on low coral islands prior to Western contact (Anderson, 2002, 2006; Pregill & Weisler, 2007; Sachs et al., 2009; Steadman, 2006; Thomas, 2009; Weisler, 2001). This contrasts with the number of environmental assessment studies carried out on these islands during the last two decades, as they face external and internal pressures, including sea-level rise, human impact on terrestrial and marine resources, urban drift and growing dependence on consumer goods. Major environmental disturbances are also well documented during the first half of the twentieth century, such as those associated with phosphate mining (on the raised limestone island of Banaba), bombings during World War II, and nuclear testing (Macdonald, 2001; McQuarrie, 2000; Perry & Garnett, 1998).

Early settlement of the Pacific and environmental impacts

With over 40,000 years of human settlement and a variety of island types, Oceania displays great ecological and cultural diversity. Yet the forces of globalisation are an ever present threat, even while creating some opportunities. Although environmental degradation and the assault on cultural expressions by the advent of modernity are not limited to islands, the latter do appear more vulnerable to disturbance compared to continental areas. In the case of oceanic islands, relative isolation has often resulted in high rates of endemicity and the loss of defensive mechanisms among plants and animals. When isolation is broken, dramatic changes can take place. Admitting that humans show more flexible survival strategies than most other organisms in coping with external pressures, island societies have also suffered. For example, many Pacific Islanders lacked immunity to a host of diseases introduced by European explorers and those who followed.

Until recently, it was generally assumed that anthropogenic impacts on island ecosystems were the result of Western influence via the introduction of alien crops, ornamentals and animal domesticates, which caused considerable damage to local environments. No one can deny that threats to island biodiversity continue at an accelerated rate as a consequence of multiple factors, including human population growth, urban expansion, monoculture, pollution and overfishing, to name a few. However, the last 40 years of research have drawn attention to the fact that indigenous groups have also contributed in altering their environment to a significant degree on both large and small islands (Anderson, 1989; Denham, 2006; Kirch & Yen, 1982; Rapaport, 2006). These impacts can sometimes be traced to the early phases of human settlement, leading in some cases to resource depression, extirpation and extinction.

From the 1970s onwards, archaeologists working in the Pacific, with support from environmental scientists, have contributed towards our understanding of the processes of landscape change.
coinciding with the arrival of early settlers and continuing throughout the pre-European contact period. By contrast, the influence of indigenous groups on marine ecosystems is less well documented (Allen, 2003; Anderson, 2008; Erlandson & Rick, 2008; Morrison & Hunt, 2007).

While the importance of food production to early inhabitants still needs to be demonstrated, agriculture later gained in importance, to the extent that islands became largely transformed into anthropogenic landscapes. No doubt some of these human-induced impacts had a destructive effect on island biota, but it is difficult to imagine human life on low coral atolls without root and tree crops. For that reason, atoll islets have been characterised as ‘consummate man-made environments’ (Kirch, 2000:181).

In addition to assessing the degree of environmental change across time and space, historical ecologists are challenged in their attempts to disentangle the effects of natural processes from those induced by humans (Allen, 2006; Amesbury, 2007; Aswani & Allen, 2009; Fitzpatrick & Donaldson, 2007; Morrison & Addison, 2008; Nunn et al., 2007). Coastal zones and small islands present certain difficulties in view of their susceptibility to natural changes linked to sea-level rise, tectonic events, coastal erosion or sedimentation, storms and other ecological perturbations (Fitzpatrick, 2007).

The inclusion of indigenous oral traditions in historical ecology analysis demonstrates ways researchers can make their work more relevant to local communities. Authenticated or partly authenticated oral traditions related to vanished islands, some of which supported human settlements, have been recorded throughout the Pacific (Nunn, 2009). In most cases, it is unclear when these islands disappeared. Others have a more detailed history. Similarly, oral traditions, combined with archaeological data, ethnohistorical records, ethnographic research, palaeoenvironmental data, genetic sequencing, linguistic information and other sources of data can assist in building understanding of how and why different degrees of interaction and isolation affected island societies at various points in time (Fitzpatrick, 2008; Matisoo-Smith & Robins, 2004).

**Kiribati: physical and cultural setting**

Kiribati consists of 33 atolls and table reefs spread over an area exceeding 3 million km² of ocean. The total land area, however, only slightly exceeds 800 km². As islands formed by biogenic agents (unconsolidated carbonate sediments deposited by waves on reef platforms) atolls and table reefs or low coral islands without lagoons can be regarded as especially constraining habitats for human communities. The challenges people faced, in both past and present, include low soil fertility, absence of perennial surface fresh water and extreme vulnerability to flooding by storm surge because of low elevation of the highly fragmented landmass, only a few metres above mean sea level.

The islands of modern Kiribati cluster into three island groups: the Gilbert, Phoenix and Line Islands. Archaeological evidence indicates human settlement of the Gilberts about 2,000 years ago (Di Piazza, 1999) while the Phoenix and Line Islands appear to have been settled much later, by about AD 1200. By the time Europeans re-discovered the latter two island groups, no indigenous communities were encountered, having become extinct or migrated elsewhere (Anderson et al., 2000; Di Piazza & Peartree, 2004). What was the key to human survival in the Gilberts? What led to the demise of communities in the Phoenix and Line Islands? Are there lessons about human adaptability from the past relevant to the present and future?
Contemporary challenges are not much different from those encountered in the past, such as small, fragmented and widely dispersed landmass and other environmental factors listed above. In other instances, population growth and consequent pressure on existing resources and infrastructure, as well as climate change associated with global warming, have exacerbated an already precarious balance between people and their environment (ADB, 2009a).

‘Technocratic’ solutions, associated with donor-assisted projects, might be appropriate in some cases; for example, in improving water and sanitation systems in urban areas or the application of technology to counter the effects of sea-level rise through aquaculture of reef-building organisms (JST/JICA, 2010). The Asian Development Bank (ADB, 2009b:25) notes the importance of systematic efforts ‘to exploit the beneficial synergies between adaptation and mitigation’, citing the promotion of atoll food crops, both indigenous and introduced, within the context of climate change.

The challenge facing Kiribati and other atoll nations will be the maintenance or restoration, albeit in modified form to suit changing circumstances, of traditional ecological knowledge and practices, together with selected and judicious application of outside knowledge and technologies.

**Atoll agriculture**

Dickinson (2003, 2004) drew attention to the significance of early cultural horizons on central Pacific atolls prior to the inferred drawdown in hydro-isostatic sea level (AD 1000–1200), which could be attributed to greater tidal range allowing for the accumulation of unconsolidated sediment prior to sea-level decline. Once Pacific atolls became suitable for human habitation after islets of sufficient size had formed and vegetation taken hold, colonists faced several challenges, particularly in setting up a viable subsistence base given low soil fertility and in some cases inadequate rainfall (Clark, 2010).

Coral island societies relied heavily on tree crops, including breadfruit, pandanus and coconuts, not only to meet their dietary needs, but also to supply raw material for a host of products (Thaman, 1990). Agroforestry is a distinguishing characteristic of the earliest agriculture in the Pacific islands and is still a prominent component of contemporary atoll landscapes, even in urbanised settings in houseyard and urban gardens. In addition, food preservation technology no doubt reached its zenith on the atolls, as people developed ways to process certain foods that could last through periods of scarcity and for use as sea rations. Fermented breadfruit, dried pandanus paste and dried arrowroot starch could sometimes be stored for years.

The most outstanding features of Kiribati and other atoll landscapes, particularly in the wetter islands, are the giant swamp taro pits. Archaeological research in the neighbouring Marshall Islands indicates early evidence of vegetation clearing and swamp taro pit excavations (Weisler, 1999). Ongoing work related to similar agricultural practices in the Gilberts has so far revealed evidence of human activity, between the 5th and mid-7th centuries AD, in ‘mounded’ areas adjacent to a swamp taro pit in North Tarawa. Equally significant was the identification of several plant microfossils in sediment samples of species commonly associated with human occupation of atolls.

Taro pit cultivation has witnessed a general decline on many atolls today. The reasons are varied and include damage by introduced pigs, crop disease, growing dependence on food imports and increasing salinisation of the water table associated with global warming and sea-level rise (Thomas, 2003).
Known as *te bwabai* in Kiribati, over 20 cultivars of giant swamp taro have been identified, with some varieties grown mainly for prestige and ceremonies. As described by Thaman (1990), swamp taro cultivation entails a very sophisticated system of mulching and fertilisation using leaves from a variety of trees. Pits are excavated down to the freshwater lens, commonly in the centre of an islet, where the lens is thicker. Some of the pits are lined by coral boulders. Those who still practise this form of food production have their own secret techniques of composting.

**Meeting water needs**

Most of the Gilberts and several of the Line and Phoenix Islands are located in the dry belt of the equatorial oceanic zone. Periods of drought are well recorded historically. The most common way of accessing water was through the digging of wells, but water could also be collected from coconut palm fronds and trunks and empty giant clam shells. Drinking coconuts and toddy (coconut sap) could also provide fluids and certain nutrients.

**Management of marine resources**

The very high ratio of reef to land area, typical of most atolls, provided early settlers and their descendants with an abundant source of protein as well as raw material (fish bone, empty shells) for the manufacture of tools and ornaments (Koch, 1986). Fishponds and fish traps made from loosely built walls of coral boulders were used extensively before Western contact.

What is less clear, however, is the extent of human impact on the marine environment. Elsewhere in Oceania, there is evidence that overfishing by indigenous communities resulted in species-size reduction, particularly of shellfish, that can sometimes be distinguished from the effects of natural disturbance or climate change (Allen, 2003). Relatively low human population densities and low impact extractive technologies were probable reasons why several atoll communities were able to live sustainably. Moreover, it may be that the success of some of these communities rested partly on a more pronounced awareness of resource limitations, and thus the need to be more attentive to their conservation and management compared to people living on ‘high’ islands (Smith & Wishnie, 2000; Zann, 1985).

**Coping with natural disaster and climate change**

Environmental risk can be reduced by the use of social capital. Kinship networks and land tenure systems enabled people to maximise choice of residence and local group affiliation.

Interisland contacts would confer advantages in the event of demographic instability and chronic shortages in food or raw materials as a consequence of environmental perturbation, such as that caused by drought or cyclones. Because of their overall marginality, atolls occupy a prominent position in discussions centred on exchanges. Atolls may be connected to high islands (Alkire, 1978), but in the absence of the latter, elaborate networks were also established (Spennemann, 2006). Within the Gilberts, oral traditions refer to sub-regional networks (Grimble, 1972). There has been too little archaeological work in the area to provide much supportive evidence for extensive trade networks.

Using a regional approach to understand island settlement and abandonment in the Line Islands, Di Piazza and PEARthree (2001) concluded that resource scarcity and/or isolation resulting in
abandonment served as explanation only for those islands that were relatively inaccessible, small and/or dry. Some islands appear never to have been inhabited, perhaps because they were too marginal in terms of water availability or because their surrounding reefs prevented effective fishing. Archaeological surveys on the wetter atolls in both the Line and Phoenix groups yielded higher site densities, suggesting relatively large resident populations having access to a rich agricultural base by atoll standards, as evidenced by the existence of agricultural pits (Di Piazza & Pearthree, 2004). These communities might have periodically exploited nearby atolls for seabirds or turtles. The demise of the main settlements remains problematic, but the occurrence of exotic volcanic material, together with the abundance of timber for canoe building, should serve as a reminder that populations were capable of migrating to other archipelagoes.

A breakdown in long-distance voyaging occurred by ca. AD 1450. Nunn (2000, 2007) has attributed this to climate change, subsequent to the ‘AD 1300 Event’ and the onset of the Little Ice Age (Behringer, 2010; Fagan, 2000). Greater storminess, followed by cooler and drier weather and a postulated decline in sea level, and thus nearshore productivity, could have conspired to bring about complete abandonment of the Phoenix and Line Islands a mere two centuries after initial colonisation from other parts of Polynesia. Evidently, populations in the Gilbert group survived, perhaps because they were less isolated from other archipelagoes so more able to draw on resources and people when faced with demographic instability (Grimble, 1972; Lewis, 1978).

On small marginal islands, the need to devise strategies for managing population growth may have arisen rapidly, so as not to outstrip resources (Bedford & Macdonald, 1982). Warfare, cannibalism, infanticide and abortion may contribute to population regulation, but there were also nonviolent means such as ritual celibacy, prolonged lactation, adoption and several other measures.

**Lessons learnt**

The past may offer some lessons for managing the present and perhaps the future. Sustainable agricultural practices (organic farming and promotion of resilient crops) should reduce dependency on expensive food imports, improve food security and nutritional health, create employment and strengthen links with biodiversity conservation, including ethnobiological diversity. Major challenges include salinisation of the water table, population pressure, out-migration (from the outer islands to the capital, Tarawa) and land disputes, as well as owner absenteeism and pilferage (Thomas & Tonganibea, 2007).

Local communities on outer islands need to be encouraged to manage marine resources by limiting access to fishing grounds, while the central government should formally sanction such action. The high costs of fossil fuels might be an incentive to use cheaper modes of transportation, such as outrigger canoes, and the revival of navigation techniques, linked with traditional fishing knowledge, and village-based mariculture (e.g. milkfish, giant clams) to strengthen food security (Thomas & Teao, 2010).

Sea-level rise has been described as the most pressing environmental issue facing atoll nations (Neemia-Mackenzie, 2004). In his report for the *Kiribati Adaptation Project*, Neemia-Mackenzie notes the difficulty people face in identifying traditional coping mechanisms and strategies because of the rapid changes occurring as a result of global warming. The building of sea walls, *te bono*, appears to be a relatively good local solution, but one that needs to adapt to the prevailing conditions. By changing
the design of walls from ‘steep face to the sea’ to ‘sloping side facing the sea’, thus mimicking the form of a natural beach, the shoreline could be more adequately protected.

Other responses to climate change that could tap into traditional knowledge and practices include maintenance of vegetation and planting suitable trees along the shoreline (e.g. mangroves) and around households to reduce erosion and the sun’s heat, retention of traditional thatched dwellings, which are cooler and easier to replace, and documentation of traditional weather forecasting knowledge (Teaero, 1997).

**Conclusion**

While the past, as documented through historical ecology, can provide some of the knowledge and tools for sustainable livelihoods, we also need to be critical of the effectiveness of traditional coping strategies under new conditions of growing population, altered land- and seascape, escalating climate-related hazards, and changes in community and individual needs. With this caveat, we should continue to look at culture as a vital link between past, present and future. Several atoll communities managed to live sustainably for centuries, and their achievements deserve to be recognised and celebrated.

Knowledge and practices are dynamic, just as cultures and societies are. Culture on the atolls and other islands in the Pacific is still firmly rooted in community obligations. Kin- and community-related activities can reduce risk and uncertainty. Reciprocity as embodied by the concept of *bubuti*, a request that cannot be refused, best exemplifies the close ties between people living in a challenging physical environment. As the anthropologist Tony Whincup (2010) remarked, the ‘integration of people and place’ for I-Kiribati (the people of Kiribati) has indeed become an imperative of survival. An integrated understanding of land- and seascapes for sustainable livelihoods is strongly linked to a sense of place. Historical ecology has often documented the transformation of place, whose main custodians today, the local communities, will need to take on an increasingly active role to manage their biocultural world successfully.

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