ELSEVIER

Journal of Archaeological Science 35 (2008) 126–142

Journal of Archaeological SCIENCE

http://www.elsevier.com/locate/jas

Plant microfossil analysis reveals disturbed forest and a mixed-crop, dryland production system at Te Niu, Easter Island

Mark Horrocks [a,b,*], Joan A. Wozniak [c]

[a] *Microfossil Research Ltd, 31 Mont Le Grand Road, Mt Eden, Auckland 1024, New Zealand*
[b] *School of Geography and Environmental Science, University of Auckland, Private Bag 92-019, Auckland, New Zealand*
[c] *Wozniak Archaeological Consulting, 27111 Briggs Hill Road, Eugene, OR 97405, USA*

Received 7 November 2006; received in revised form 27 February 2007; accepted 27 February 2007

Abstract

Plant microfossil analysis was carried out on 12 soil samples from a variety of landscape features at three locations (100–250 m a.s.l.) along a 950 m transect at Te Niu, Easter Island. Pollen and phytolith assemblages were dominated by palms and ground ferns, and suggested disturbed forest. We identified pollen of bottle gourd (*Lagenaria siceraria*) and starch grains of the common yam (*Dioscorea alata*), sweet potato (*Ipomoea batatas*) and taro (*Colocasia esculenta*). The data suggest a mixed-crop, dryland production system at Te Niu dominated by yam and sweet potato, and supplemented by taro and bottle gourd. The data provide direct evidence of crop type and range, supporting the indirect evidence (topographic and landscape features, field and historical research, comparisons with elsewhere in the Pacific) that much of the rock covered landscape of Easter Island was used for intensive horticulture.

Keywords: Agriculture; Plant microfossils; *Dioscorea alata*; *Ipomoea batatas*; *Colocasia esculenta*; *Lagenaria siceraria*; Easter Island

1. Introduction

Easter Island (Rapa Nui) is famous for its giant stone statues (*moai*) placed on stone platforms (*ahu*). The exact date of arrival of the Polynesians who built them is debated. Based on radiocarbon dates from archaeological layers containing bones of birds that were exterminated quickly on Easter and many other Pacific islands, Steadman (1995) suggested a little before AD 900. This timing is accepted by most researchers (Ayres, 1971; Green, 2000; Martinsson-Wallin and Crockford, 2001), although Hunt and Lipo (2006), based on their own excavations and re-analysis of previous radiocarbon dates from the island, suggested a later colonisation of AD 1200.

Moai-carving and *ahu* construction is thought by many researchers to have commenced on Easter Island c. AD 1000–1100 (Ferdon, 1961; Ayres, 1975; Martinsson-Wallin, 1994; Stevenson, 1999) and lasted until AD 1680 (Routledge, 1919; Metraux, 1940; Englert, 1974), when according to oral history, many *moai* were toppled from their *ahu* during a period of intensified warfare. The onset of warfare is attributed to resource depletion and ecological collapse by Bahn and Flenley (1992) and Diamond (1995). However, while *moai* carving may have ended in the 1600s, *ahu* construction and reconstruction took place until the mid-1800s.

Ahu-construction and *moai*-carving presumably required a large population and therefore intensive food production. Archaeological remains of stone chicken houses, and also house gardens and horticultural fields cover a large part of the island's surface, especially within 2 km of the coast (McCoy,

* Corresponding author. Microfossil Research Ltd, 31 Mont Le Grand Rd, Mt Eden, Auckland 1024, New Zealand. Tel.: +64 9 630 5787; fax: +64 9 373 7434.
E-mail address: info@microfossilresearch.com (M. Horrocks).
URL: http://www.microfossilresearch.com

0305-4403/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jas.2007.02.014

1976; Vargas, 1998). Much of the island was deforested to accommodate this food production, and for material needed in house construction and *moai* transport (Flenley and King, 1984; Flenley, 1991; Gurley and Liller, 1997; Grau, 1998; Orliac, 2000). Between AD 1300 and the mid-1600s, herbaceous plants and twigs increasingly replaced hardwoods as cooking fuel (Orliac, 2000). Stevenson (1999) and Stevenson et al. (1999) suggested that horticulture was being practiced extensively over much of the island during this period. The first European visitors, which included Roggeveen (AD 1722), Gonzalez, Cook and La Perouse (AD 1770s), noted extensive cultivation of crops such as sweet potatoes, taro, yams, and bananas on an almost completely treeless landscape.

Systematic archaeological research of Easter Island agriculture began in 1989 with Stevenson's (1999) long term study of dryland horticulture at Maunga Tari (Fig. 1). He suggested that inland areas with good soil and adequate water were used for intensified gardening beginning in the early 1400s. In 1996, Wozniak (1999, 2003) surveyed and excavated part of the northwest coast at Te Niu (Fig. 1) to identify and describe ancient horticultural soils and garden structures, determine their geomorphic contexts and assess environmental change associated with garden construction. Extensive areas of garden or *maori plaggen* soils (McFadgen, 1980) covered with "lithic mulch" (Lightfoot, 1996) were identified as gardens during this project. Stevenson and Haoa's (1998) work in La Perouse (Fig. 1), which began in 1995, demonstrated that household gardens and fields extended from the coast inland for 2–3 km. They also found lithic mulch at many of these cultivation areas. In 1996 Martinsson-Wallin (1994) joined the La Perouse project and excavated at Ahu Hekii near La Perouse.

During these projects, one of us (JAW) collected soil samples to look for microfossils of cultivated plants. The samples were from under an *ahu* at Te Niu (dated to AD 1450), under the ramp at Ahu Hekii (dated to AD 1300–1600), from a cave at Te Niu (AD 1400s), and also from possible gardens at La Perouse (one dated to AD 1300–1700). The analysis was carried out by Cummings (1998) who identified the following cultigen microfossils: pollen of sweet potato, Pacific Island cabbage tree and Moraceae (possibly paper mulberry); starch grains of taro; and a probable banana phytolith. She concluded that preservation was sufficient to recommend further microfossil analysis to identify garden areas.

The various archaeological studies document evidence for the spread of intensive, rainfall supported horticulture on Easter Island by the selective use of swales (deeper, damper, more fertile soil), and the construction of features such as rock-walled gardens (wind protection), stone circle-defined planting pits, and the aforementioned lithic mulch (moisture and heat retention, wind erosion protection) (Stevenson and Haoa, 1998; Stevenson, 1999; Wozniak, 1999, 2003; Stevenson et al., 2005, 2006). For the first 500 years of occupation, cultivation was carried out within 1–2 km of the coast, while the three main volcanic peaks of the island most likely remained forested. After AD 1500, much of the remaining forest was replaced by gardens (Mieth and Bork, 2003).

Louwagie et al. (2006) applied land evaluation to assess the productivity of traditional crops (sweet potato, taro, yam, sugar cane and banana) on Easter Island. Soil profiles distributed over four sites, Akahanga, La Perouse, Tepeu and Vaitea (Fig. 1) were selected as land evaluation units. Their model included spatial and temporal rainfall and temperature variability, and anthropogenic response. Rainfall and temperature of Easter Island were assessed as near optimal for sweet potato, moderate for banana and almost marginal for taro, yam and sugar cane. They suggested that responses to these variables may have included lithic mulch, land use planning and supervision of food production. Louwagie et al. (2006) concluded that these adaptive strategies explain why prehistoric Easter

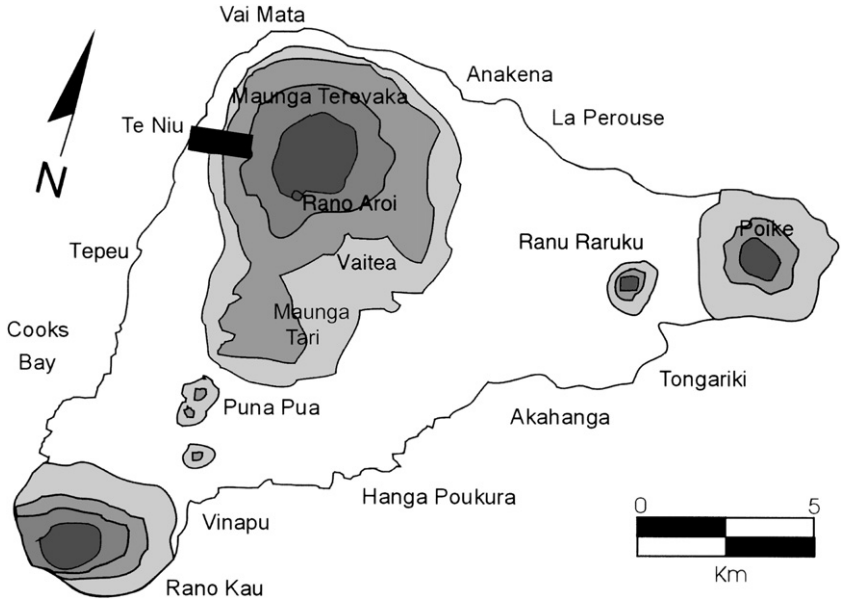

Fig. 1. Easter Island and the Te Niu project area.