MAPPING REGIONAL VARIATION IN SETTLEMENT IN LATE PREHISTORIC NEW ZEALAND

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Introduction

This paper draws attention to recent predictive modelling of pa and pit site distributions (Leathwick 2000) and explores some of the implications of the work for understanding regional variation in late prehistoric New Zealand.

A Predictive Model of Pa and Pit Distribution

Geographic information systems (GIS) provide a means to analyse and interpret large amounts of data. There are a number of different multivariate statistical techniques that may be used to explore associations between environmental variables and archaeological site distributions. The assumptions are that settlement choices are strongly influenced or conditioned by characteristics of the natural environment; and that the environmental factors that influenced these choices may be portrayed, at least indirectly, using modern data on environmental variation. Such models work because archaeological sites tend to recur in environmental settings favourable to human settlement (Warren and Asch 2000: 6).

A pilot study by Leathwick (2000) of Landcare Research for the Science & Research Unit of the Department of Conservation employed data on 11,251 pa and pit locations from the New Zealand Archaeological Site Recording Scheme to define the environmental correlates of these two site types. Logistic regression was used to indicate bias towards or away from particular environments. The advantage of this approach is that it begins with what is known about the location of archaeological sites and searches for key environmental variables, rather than assuming what those variables might be. Major factors identified in the study were soil parent material and distance to major water bodies, followed by mean annual air temperature. Pa and pit sites occur most frequently in environments in close proximity to water bodies and having warm temperatures, high solar radiation, mild winters, and dry summers (Leathwick 2000: 7).

The Leathwick predictive model (available on the web at www.nzarchaeology.org/elecpublications/ predictive.htm) estimates the relative probability of pa and pit sites occurring in an area. Pa and sites with pits were chosen for the analysis because (1) the data were archaeologically robust and provided a large data set, (2) there is known to be considerable overlap in the distributions of pa and pits, and (3) both site-types are thought to be strongly correlated with kumara-growing. Shell middens were not considered for the pilot study as their occurrence is correlated with proximity to shellfish sources. Data on other classes of sites also have deficiencies that made them unsuitable for this particular study.

There are, of course, problems with the use of pa and pits and, in particular, with the use of both together. The term 'pa' includes a range of fortified sites of different form and function. Refuge pa often occur in naturally inaccessible locations and therefore probably have a somewhat different environmental context than pa (fortified settlements) generally. Refuge pa, however, make up only a small percentage of recorded pa. The term 'pit' is used for features with a variety of shapes and sizes and recorded pits do not always represent kumara storage pits. As with refuge pa, the effect of including pits not used for storage is to extend the environmental range for this class of site. By using both pa and pits in the study a composite was created sharing the environmental characteristics of both. Use of these data, with all their limitations, allows the accumulated results of decades of fieldwork to approximate the choices about location made in the past.

Previous Models

Over fifty years ago, geographers divided New Zealand into three major regions of varying suitability for prehistoric settlement (Cumberland 1949; Lewthwaite 1949). They suggested that towards the end of prehistory in the late eighteenth century up to 80% of the population was concentrated in the northern region, 15% in the central region, and less than 5% in the southern region. Davidson (1984: 35) notes that 'this three-fold division of New Zealand has been widely used by archaeologists and as a gross indication of the distribution of favourable zones for Polynesian settlement it is very useful.' Gorbey's (1970) study of the distribution of over 3000 pa confirmed the extent of the northern region as defined by Cumberland and Lewthwaite and suggested that it was possible to use the density of fortified sites to model the relative population distribution in late prehistory (Green 1974: 31).

In terms of settlement and population, the Leathwick predictive model confirms the usefulness of a threefold division of the country at a broad spatial scale and suggests that all three regions as previously defined have considerable validity. Inevitably there are some differences in detail, as the predictive model employs a mass of archaeological data and is more sensitive to environmental variables than earlier studies. As would be expected, regions such as Northland, Auckland, Hauraki, Coromandel, Waikato, Bay of Plenty, East Coast, Hawke's Bay, and Taranaki all contain extensive areas that rate highly as favoured areas for settlement.

The likely occurrence of pa and pits in central and southern areas is largely confined to a thin coastal strip, and favourable areas tend to be fewer in number and smaller in extent moving south. The predicted probability of pa and pit sites is very low over much of the inland southern North Island and all of the South Island. The low probability in these areas is interrupted only in places with special characteristics. In the North Island, the Lake Taupo district is the most extensive and notable of these, probably because of the availability of freshwater food resources.

Another influential model, and one which has a particular focus on identifying and ranking kumara-growing areas, was developed by Groube (1970). Groube (1970: 156) estimates that over 98% of recorded fortifications fall within the area where horticulture could be practised. He suggests that the horticultural importance of different regions within New Zealand would have varied considerably and ranked regions on the basis of the length of the growing season as reflected by ground frost/screen frost records. He grouped regions into four: kumara littoral climates, second priority climates, difficult kumara climates, and special environments (Groube 1970: 160-161). Challis's (1992) detailed study of the archaeology of the Nelson-Marlborough region is one of a number that have found that broad national models, such as Groube's, provide only a general picture and considerably over-simplify the picture. This indicates the desirability of manipulating large amounts of archaeological and environmental data in studies so that they are more sensitive to regional and local variation.

The use of weather station records to assess the suitability of areas for prehistoric kumara cultivation has severe limitations (Challis 1992: 102). The actual choices made by prehistoric inhabitants are, however, reflected in archaeological site distributions. A predictive model based on identifying the environmental contexts of different classes of sites will take into account, for example, shifts in the frost regime over space and time. For this reason, the different levels of probability of occurrence of pa and pits in the Leathwick predictive model should give a better indication of the relative importance of kumara-growing areas than any based on one or two environmental factors.

Groube (1970) identifies the Central East Coast (Bay of Plenty and East Coast) as a second priority climate. Parts of Hawkes Bay are grouped in Southern Interior region as a difficult kumara-growing climate. All these areas are identified in the Leathwick study as important kumara-growing areas. Another mis-match between the two models concerns the Southwest Coast and Northern South Island region that Groube identifies as a second priority climate. This undoubtedly over-rates the significance of the region. The region includes parts of Manawatu, which the Leathwick predictive model identifies as having a low probability of the occurrence of pa and pits, and the coastal northern South Island, which on current evidence is at best a difficult kumara-growing climate.

Conclusions

The Leathwick predictive model provides a measure of the potential of an area for late prehistoric settlement. Discrepancies between the expected pattern and the documented pattern may be due to a range of factors including site destruction, local environmental variables not accounted for in the analysis, or the potential not being fulfilled e.g. because of the shortness of the prehistoric sequence.

The model tests long-standing conclusions about the pattern of late prehistoric settlement in New Zealand, confirms their general validity, provides a more detailed picture of the likely distribution of settlement in late prehistory, and gives some indication of the relative importance of different areas. It also has obvious applications in the area of archaeological resource management, if it can be scaled up to 1:50,000 and additional classes of site are added to the analysis. The larger scale would allow, for example, more effective preliminary screening of development projects than use of inventory data alone. Predictive models provide a cost-effective way to target areas requiring resources and management effort.

The Leathwick predictive model arose from a pilot project by Landcare Research Ltd for the Department of Conservation. The major limitation is the small scale employed and a larger scale will be used in future work. This will include modelling pa and sites with pits separately, a study of shell middens, and separate analyses of all prehistoric sites in the North Island and all prehistoric sites in the South Island.

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