ARCHAEOLOGY IN NEW ZEALAND

HOW BIG ARE PĀ?

TONY WALTON
DEPARTMENT OF CONSERVATION,
WELLINGTON

The number, distribution and antiquity of pā are now reasonably well known. As of 31 March 2006, 6950 pā had been recorded in the New Zealand Archaeological Association Site Recording Scheme. They are largely a North Island phenomenon with 98% located there. Their construction and use has been firmly placed in the period of about 300 years between the early 16th and the mid 19th centuries (Schmidt 1996). Pā are very diverse in form and extent. Detailed plans of individual pā provide evidence of the size of the sites concerned but what is lacking is a context which would give these figures meaning. In summary, what remains obscure is what the pā size frequency distribution looks like.

Much discussion of pā has taken place without the benefit of any statistics on the size of pā as a class of sites. Both Fox (1976) and Davidson (1984) provide plans with scales to illustrate their discussion of pā but largely leave inferences about size or area to be drawn by their readers. When size is discussed it is in relation to the likely number of inhabitants. As there was wide variation in the size of the resident group, readers are left to infer that pā might vary considerably in size.

Figure 1 is a plan of Paeroa pā (Q05/39 [N12/1]) in the Bay of Islands based on a plan of 1772 as shown in Davidson (1984: 161). It is about 2420 m² in area. Pā situated on headlands with single transverse ditches and banks are the most common form of pā (unpublished data). Most archaeologists would probably think that Paeroa is a pā of average size, but on what are they basing their judgement, and how well founded is it in the absence of data on pā generally? Figure 2 is a plan of Taniwha pā (S13/2 [N52/1]) in the Waikato, again as depicted in Davidson (1984: 124). It has an area of about 4640 m². If Paeroa is of fairly average size, is Taniwha then a large pā? And if Taniwha is large, what description is used for One Tree Hill/Maungakiekie (R11/14 [N42/6])? This pā covers an area of about 171,600 m² (17.2 ha). It is difficult to make these assessments without having data on the size of other pā to provide a context. Considerable data on pā sizes has been generated since the early 1980s, particularly in university theses with a regional focus.
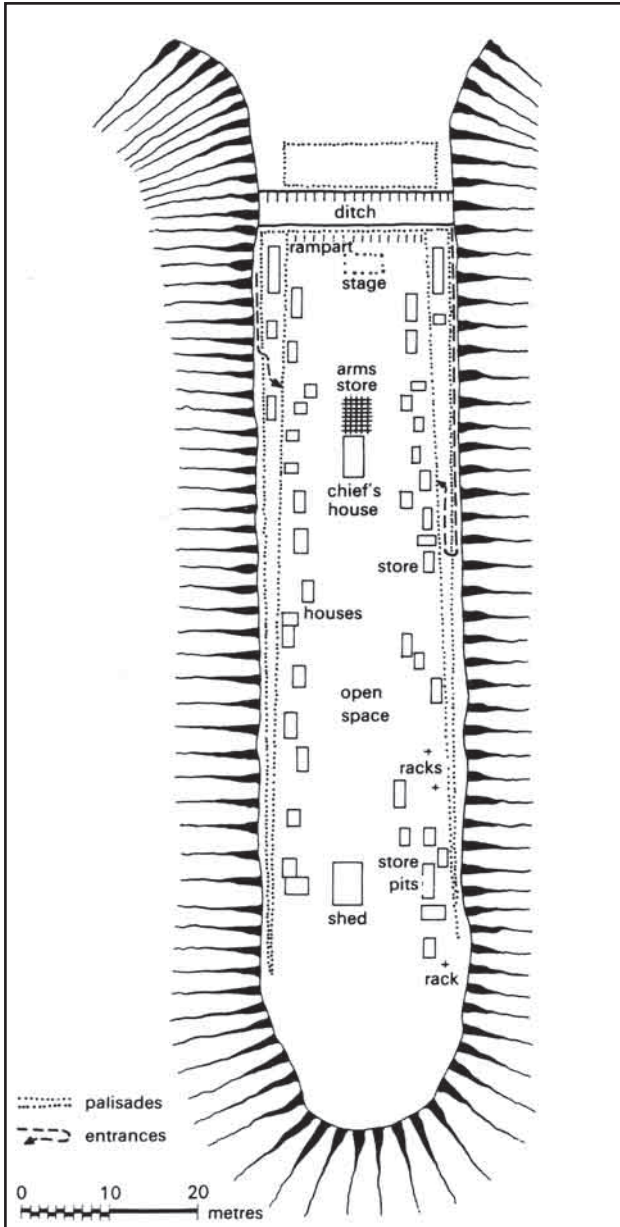
Figure 1. Paeroa pā (from Davidson 1984: 161). Reproduced by permission.

Figure 2. Taniwha pā (from Davidson 1984: 124). Reproduced by permission.

This, then, is a preliminary study on the size of pā. It is not easy to accurately and precisely measure the size or area of individual pā. An instrument survey provides a solid basis for determining area but often all that is available is a plan of much lesser accuracy and precision. This latter type of plan may allow area to be measured, and a useable result obtained, but it is little more than an estimate. And, if there is no clear perimeter in places, what areas are included as integral to the site and what are not?

Most of these limitations of the data are unavoidable, so the only claim made here is that the area used for any particular site is probably of the order of the given figure. The data is good enough to draw general conclusions, but detailed interpretation and comparison of different regional samples has been deliberately avoided. In spite of the limitations of the available data, it is useful to see what the picture looks like and what information about pā may be inferred from a pā size frequency distribution.

Two approaches to measuring pā size

There are two approaches evident in the way that pā have been measured. One approach focuses on the total 'footprint' of the site, including the defences and any unusable space in the interior taken up by slopes and scarps. The other approach primarily wants to know what area was used for habitation, i.e., platforms, terraces, etc., and so does not include those parts of the pā not actually used as living areas. This approach generally requires a higher standard of plan and tends, therefore, to be less favoured.

The living areas only approach was taken by Prickett (1980, 1982, 1983) in Taranaki and Phillips (1987) at Karikari Peninsula, while Allen (1994) measured only specific features such as tihi and house floors in his study of Hawke's Bay pā (Figure 3). The defences can make up a large proportion of the size of a site, particularly if it is a ring ditch pā. Burridge (1995: 81), for sites near Tirau, shows that anywhere between 42% and 74% of the area of pā were occupied by defences. There may be a tendency, depending on topography, for smaller sites to have a larger proportion of their area occupied by defences. The living areas only approach tends, therefore, to produce smaller areas than total area.

It is useful to consider the data generated by this approach here, as the rest of the paper is concerned with measurements of total area (Table 1).

Table 1. Living area: two data sources.

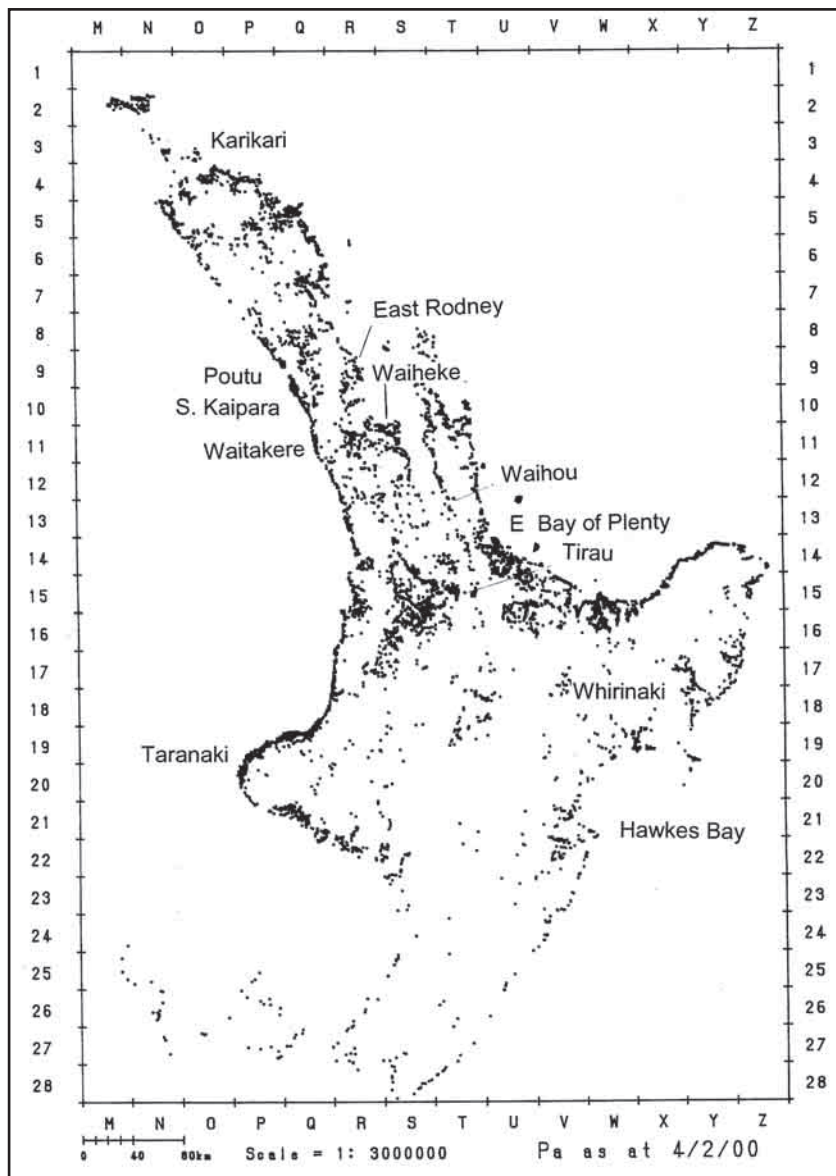| Source	sample	pop	%	min	max	median	mean	<1000 m²	<5000 m²
Prickett 1980, etc.	89	91	98	80	55000	450	2210	70%	85%
Phillips 1987	19	19	100	40	950	320	347	100%	100%

Figure 3. Pā distribution and particular areas represented in samples.

Prickett (1980, 1982, 1983) provides figures for habitable area for 89 out of 91 pā, covering almost all sites in his sizeable study area. The range is from 80 m² to 55,000 m², with a median of 450 m² and a mean of 2210 m². Most pā are small, with 70% less than 1000 m² and 85% below 5000 m² of living area.

Phillips (1987) provides data for all 19 known pā in her Karikari Peninsula study area. The range is from 40 to 950 m², with a median of 320 m² and a mean of 347 m².

Superficially, the data suggests that Karikari pā as a group are generally smaller in terms of their living areas. The means are very different but the difference is largely due to a small number of large sites in the Taranaki sample. The medians are not far apart, however, and this is a pattern observed in all the data sets. The median invariably proves more representative of the majority of sites than the mean.

Much of the available data on pā size uses the overall footprint, including defences and interior slopes. This data is easier to generate, but accuracy and precision varies from study to study. O'Keeffe's (1991) Western Bay of Plenty data is based on good plans and precise and accurate measurement. Many other data sets are variable in terms of plans used and the way measurements were generated. Many of the figures are rounded. Sometimes data on pā size is displayed on plans or diagrams without listing the raw data. Data relating to individual sites can be very difficult or impossible to extract.

Total area: the data

A large dataset on total area of pā was collected in 2004 by Nicola Molloy on contract to Department of Conservation. This study involved examining a random sample of 688 records from the NZAA Site Recording Scheme and extracting a range of information. Enough information was available for area to be calculated for 416 sites. In addition, data on pā size from theses and other available sources have been identified and collected. Both Prickett (1980, 1982, 1983) and Allen (1994) have provided plans of their Taranaki and Hawkes Bay sites and overall footprint has been measured from these. For Prickett's Taranaki data, the median increases from 450 to 1500 m² and the mean from 2210 to 3112 m².

The current dataset holds records for 931 sites, representing about 14% of known sites. Table 2 summarises figures on sample size, range, median, mean, and percentage of sites in the sample less than 1000 m² and less than 5000 m² from a number of sources. As previously noted, the mean is affected by the small number of large values and the median is more representative of the majority of sites.

Table 2. Total area: the data sources.

Source	sample	pop	%	min	max	median	mean	<1000 m²	<5000 m²
Prickett data	89	91	98	150	55000	1500	3112	27%	87%
Pritchard 1983	24	27	89	258	4052	987	1350	54%	100%
Irwin 1985	15	20	75	200	>20000	2200	3827	20%	80%
Lawrence 1989	39	53	74			<1000			
O'Keeffe 1991	122	445	27	299	68422	3558	6228	6%	67%
England 1993	16	46	35	600	16637	2243	3746	6%	75%
Allen 1994	108	130	83	230	189000	2550	7479	8%	71%
Phillips 1994	24	28	86	1500	20500	5400	7115	0%	42%
Burridge 1995	10	10	100	430	3715	1129	1644	30%	100%
Phillips 1996	65	91	71	150	18000	<2000		29%	91%
Spring-Rice 1996	100	120	83	600	21000	2400	3437	8%	80%
Jones n.d.	15	20	75	220	6000	1120	1801	40%	87%
Molloy 2004 (1)	416	6880	6	27	145692	1800	3255	28%	83%
Molloy 2004 (2)	44	618	7	90	19695	1180	2393	41%	91%
Combined	931	6880	14	27	189000	2100	4232	24%	82%

The Molloy sample generated data for 416 out of the 688 randomly selected sites from a population of 6880 recorded pā. The range was from 27 to 145,692 m² with a median of 2039 m² and a mean of 3605 m². 28% of sites were less than 1000 m² and 83% were less than 5000 m². A random sample drawn from pā managed by DOC generated a further 44 figures.

The other data sets used are largely from theses, and some did not provide the full set of data sought.

Pritchard (1983: 77) provided figures for 24 sites in her East Rodney study area. The sample covers most pā (89%) in the study area. The range is from 258 to 4052 m², with a median of 987 m² and a mean of 1350 m². In this area most pā are small, with 54% less than 1000 m² and all less than 5000 m².

Irwin (1985: 99) provides data for 15 sites in his Poutu study area. There are 20 known pā in the study area. The range is from 200 to >20,000 m², with a median of 2200 m² and a mean of 3827 m². 80% of the pā are less than 5000 m².

Lawrence (1989: 154) provides grouped figures for pā size for 39 out of 53 pā (74%) in her Waitakere Ranges study area. The median falls within the <1000 m² group. The pā are small, as with East Rodney, and the main difference arises from the presence of the large Korekore pā (Firth 1927) within the study area.

O'Keeffe (1991) provides figures for 122 sites for her Western Bay of Plenty study area (Figure 7). There are 445 known pā in the study area, so her sample amounts to roughly 25% (O'Keeffe 1991: 100, 168–169). The range is from 299 to 68,422 m², with a median of 3558 m² and a mean of 6228 m².

The mean is affected by a small number of large values. The number of large sites, of which a pā at Papamoa (U14/238, N58/124) is the biggest, and the low number of sites less than 1000 m², make this frequency distribution of particular interest.

England (1993: 132) provides areas for 16 out of 46 pā on Waiheke Island. The range is from 600 to 16,637 m², with a median of 2343 m² and a mean of 3753 m². The number of sites less than 1000 m² is a point of difference and may reflect a sampling problem.

Phillips (1994: 541–547) provides sizes for east and west Waihou pā sites. This is an unusual set of data, perhaps because it deals with pā on flat land. With a median of 5400 m² and a mean of 7115 m², these sites are generally in the upper range for pā size.

Burridge (1995: 72) provides areas for 10 pā in her Tirau study area. The range is from 430 m² to 3715 m², with a median of 1129 m² and a mean of 1644 m².

Phillips (1996: 42) provides grouped data for pā size for his Ohiwa Harbour study area. Measurements for 65 out of 91 pā make this a 71% sample. The range is from about 150 m² to about 18,000 m². The median falls within the 1000–2000 m² group.

Spring-Rice (1996: 186–189) provides figures for 100 sites in her South Kaipara Peninsula study area. The sample represents about 83% of the known pā. The range is from 600 m² to 21,000 m², with a median of 2400 m² and a mean of 3437 m². Along with the O'Keeffe and England studies, this shows only a small group of pā less than 1000 m² but 80% were less than 5000 m².

Jones has provided areas (pers. comm.) for pā at Whirinaki (Jones 2004). The sample represents about 75% of the known pā. The range is from 220 m² to 6000 m², with a median of 1120 m² and a mean of 1801 m².

The measurements present a fairly consistent figure for pā size but with some variation in relative frequencies from area to area. East Rodney and Waitakere both have medians of <1000 m². By contrast Waihou, Eastern Bay of Plenty, Waiheke and South Kaipara all have a very small proportion of sites in the <1000 m² class. The mean across all studies is of the order of 3800 m². Across the data sets the median is generally about a third less than the mean.

When figures from available studies are consolidated and duplicates removed the result is a data set of 916 records, which represent 14% of known sites. The data has a median of 2100 m² and a mean of 4232 m². From this data set it may be extrapolated that more than half of all known pā have areas smaller than about 2100 m² and more than 82% are smaller than about 5000

m². Some data sets, e.g. Phillips (1996), are not included in the combined sample as the individual measurements were not provided.

Discussion

Figures 4 and 5 show the data with sites grouped according to their areas. There is no significant difference apparent between the histograms showing sites grouped in classes of 500 m² and that showing classes of 1000 m². As might be expected, there are relatively few large pā and a much larger number of smaller pā. Returning to the sites mentioned in the introduction, Paeroa pā falls in a class comprising 16% of pā in Figure 5, while Taniwha pā is in a class comprising 7%. Both are above the median. Maungakiekie pā is in the very small group of very large pā.
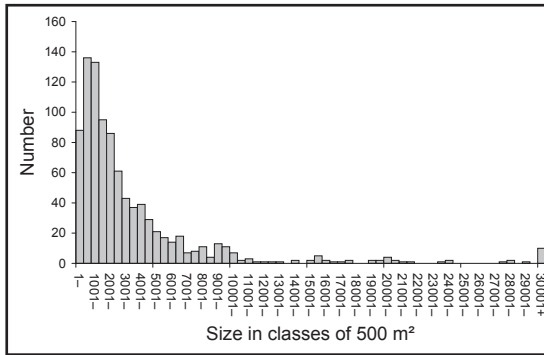

Figure 4. Pā size frequency distribution with sites grouped in classes of 1000 m².
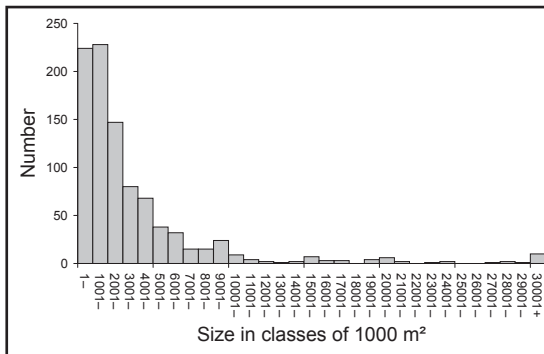

Figure 5. Pā size frequency distribution with sites grouped in classes of 500 m²

The distribution has a long upper-end tail. There a small blip in the curve around 9000 m² (which could be a sampling error). Above about 10,000 m² (1 ha) there are 60 sites (representing about 7% of the total) of various sizes up to 18 ha. Of these 60 only 8, or less than 1% of the whole sample of 916, exceed 3.2 ha.

A rank size distribution is used to show the relationship between pā size and rank. What is important is any significant change in slope. Figure 6 shows a change of slope at both ends of the distribution and this may indicate a specialised role for the very large and the very small sites. The change at the upper end of the distribution is at around 10,000 m² (1 ha). This is also a feature of other data sets such as the Western Bay of Plenty (Figure 7) showing that it is not just a peculiarity of the combined sample. If just the sites above 1 ha in size are displayed, a similar pattern is evident (Figure 8) in the upper-range tail, with a change of slope at above 3.2 ha (these figures show lower-tail and upper-tail power-law behaviour—but it is not clear what this means).

The usual explanation for very large pā is that they are part of a hierarchy of settlement which provided for a regional system of defence. Just such a hierarchy was proposed by Irwin (1985) for pā at Poutu. Larger pā provided a place for people from across a region to gather in numbers to protect themselves when threatened by large-scale incursions. Gathering together in numbers for defence is, however, not the only possible response to large-scale raids, as recourse to smaller refuge pā in inaccessible locations was also an option. Nonetheless, is a role in regional defence an explanation for the about 7% of pā on the slope at the upper end of the rank-size distribution? Does this suggest that large extra-regional threats and incursions were a common occurrence in prehistoric times? Were the large-scale raids across large parts of the country in the early 19th century a continuation of an older pattern? Or were all these large sites in use in the late prehistoric times or the early contact period?

Pouerua pā (Sutton et al. 2003) (P05/195 [N15/5]) is one of the few very large pā to have been the scene of large-scale excavations. These suggest that the pattern of features visible at the surface may represent many small changes over time, with only occasional attempts to impose a particular order on the layout. Large pā may, therefore, simply represent the cumulative effects of occupation, often short term, spread over decades or a century or more. Nonetheless, the authors (Sutton et al. 2003: 234) considered that Pouerua was part of a hierarchy of settlement. The chronology of occupation also rules out any suggestion that large pā date to late prehistoric times or the early contact period.
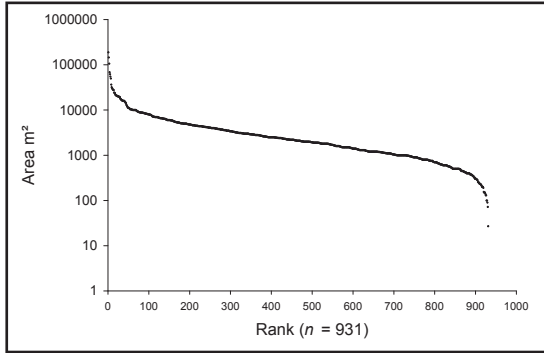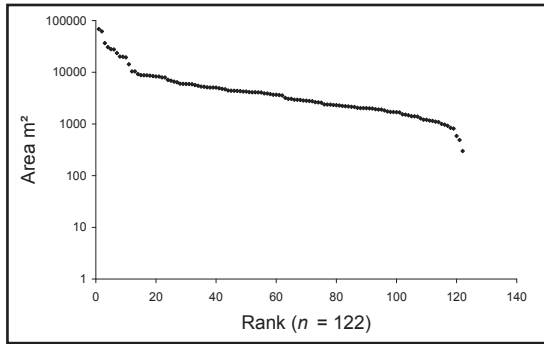
Figure 6. Pā rank-size distribution.

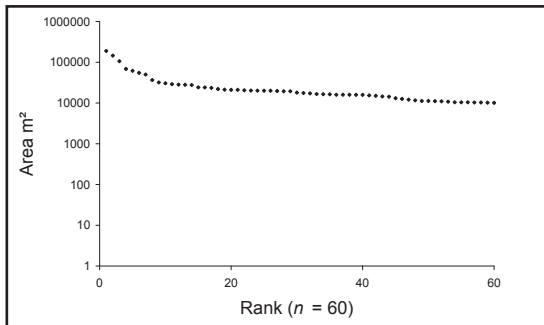*Figure 7. Western Bay of Plenty pā rank-size distribution.*

Figure 8. Pā rank-size distribution for pā over 1 ha in area.

These issues can be addressed briefly by reference to three of the very large pā represented in the sample: Mounu Kahawai (P19/203 [N108/187]), Papamoa (U14/238 [N58/124]), and Hikurangi (V21/41 [N134/1]).

Mounu Kahawai has a defended area of 5.5 ha, but it is not in a naturally strong defensive position and was overrun in about 1818 (Prickett 1983: 34). It is large in terms of area, and oral tradition indicates that it had a wider regional role for defence.

There is no indication that U14/238 at Papamoa was occupied in the 19th century. It is a large set of earthworks covering 6.8 ha. It is a large pā but it doesn't look out of place, especially when compared with other pā in the area and the Mt Maunganui 'super-pā' (U14/3118) proposed by Phillips (2003). Although the area of the proposed 'super-pā' is not stated, the accompanying plan indicates that it covers some 35–40 ha. A pā of this size is extraordinary, and requires more evidence.

Two adjoining pā in Hawkes Bay, Hikurangi and Otatara (V21/168), cover nearly 20 ha. Together they appear to comprise a large settlement site (Hikurangi) and citadel (Otatara). Hikurangi has massive storage capacity but minimal earthwork defences (Jones & Walton in press). Allen's (1994) study of Hawkes Bay pā puts the sites in their environmental and socio-political context. Hikurangi–Otatara traditionally had a wider defensive role and its size doesn't seem anomalous when seen in the regional context. Oral tradition suggests that it is early, and it had no known role in early 19th warfare. It is not evident that these sites have much in common except their size.

Conclusion

Data sets produced since the 1980s are generally consistent in identifying most pā as small, but with a few that are comparatively very large. Analysis of a data set of 916 records, representing about 14% of known pā, gave a median area of about 2100 m², with more than 80% of sites having an area of less than about 5000 m². About 7% of sites are, however, more than 1 ha in area and it is suggested that these pā may have had regional, as well as local, roles.

The data set of 916 records used in this study is reasonably large and, whatever its limitations, it is suggested that the results are likely to be reasonably representative for all pā.

Acknowledgements

Harry Jones calculated the figures for the Taranaki and Hawkes Bay sites. A Planix 7 planimeter was used, with three readings averaged per site. The Maungakiekie figure was calculated by fitting a polygon around the earthworks in a GIS and averaging three readings.

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