

Archaeological survey of the southern Hawke's Bay coast from the air

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ABSTRACT

An aerial photographic survey of archaeological sites in the southern Hawke's Bay coastal catchments was based in part on low-level (at an altitude of 2800 feet) purpose-flown small-format vertical photographs taken of selected areas, otherwise on conventional vertical aerial photograph coverage. Some site complexes were known from earlier aerial reconnaissance. The resolution of purpose-flown aerial photographs, at an original scale of approximately 1:10 000 is sufficient to reveal most detail of surface earthworks. Adequate plans can be prepared from such large-scale purpose-flown photographs, provided suitable ground controls can be observed or installed. The survey recorded 109 new archaeological sites. On this basis, eight historic landscape areas are suggested, three of which have a high priority. Tangata whenua consultation is required on these areas and they will need to be defined more precisely using an appropriate methodology. Resource management objectives and rules should also be developed for these sites and areas.

Keywords: New Zealand, Ngāti Kahungūnu, Central Hawke's Bay District Council, aerial photographs, photogrammetry, historic places, archaeological site, pre-European, prehistoric, wāhi tapu, pā, storage pits, Herbertville, Porangahau, Kairākau.

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1. Introduction

The main aims of this survey were to record all sites seen in aerial photographs, improve the database for the district plan process and develop aerial photographic methodology for archaeological mapping.

1.1 RESOURCE MANAGEMENT OBJECTIVES

Relatively few sites from the southern Hawke's Bay coastal area have been recorded in the New Zealand Archaeological Association (NZAA) site recording scheme. In an oblique aerial photograph reconnaissance flight on 11 May 1996, many unrecorded sites were noted and some preliminary records made. The purpose of our project was to use aerial photographs (conventional and purpose-flown) to identify and record archaeological sites in the area, fill some gaps in the record and make better data available for prospective iwi resource management plans and for the district plan.

The protection of sites relating to Māori is a matter of national importance under s.6 (e) of the Resource Management Act 1991 (RMA). Additionally, under s. 7 (e), anyone exercising powers under the RMA must have particular regard for the recognition and protection of the heritage value of sites, buildings, places or areas. The need for better coverage is recognised by the Central Hawke's Bay District Council, which has supported this project.

1.2 SURVEY METHODOLOGY OBJECTIVES

A second objective was to improve archaeological mapping capability from aerial photographs. Many New Zealand archaeological sites, but by no means all, have surface features which are visible in aerial photographs. Older aerial photographs (from before about 1975) are at original scales of about 1:16 000 or larger, which will show some of these archaeological features. More recent aerial photographs taken for general surveys are at original scales of smaller than 1:20 000 and only show archaeological features poorly, if at all. Depending on the area in question and the detail of individual features, conventional archaeological mapping is presented at scales of between 1:50 and 1:2500. There is, therefore, a large discrepancy between conventional aerial photograph scales and those most in use by archaeologists for individual site mapping.

For aerial coverage of smaller ground areas and particular subjects, there is now widespread use of small-format (i.e. medium-format in conventional photography) photographs with 6×6 cm or 6×4.5 cm negatives (Warner et al. 1996). These provide high-resolution photographs of selected small areas (from 100 m² to 1 km²) in readily available professional and other, cheaper, film types. Such photography is increasingly being used in archaeology and potentially provides an inexpensive mapping base (e.g. Jones 1996-97,1999). There are several possible methods for mapping off aerial photographs. An objective of our

project was to establish and recommend straightforward mapping methods. One of the initial objectives was to assess the plan error in small-format photographs—i.e. the difference between the true position of a point in the horizontal plane and its position as shown in the vertical aerial photograph (see Appendix 1). At the time of writing, software which would allow for an analysis of errors was not installed or widely available on the New Zealand Department of Conservation (DOC) network. Software that would enable digitised mapping from transformed (computer ‘rubber-sheeted’) photographs (Wilson 2000: 230) was not available within the budget of this project.

The New Zealand Archaeological Association scheme has been adopted by DOC as its primary recording system for archaeological sites. The scheme is widely used by iwi, archaeological consultants, developers, local authorities and the New Zealand Historic Places Trust in their various resource management roles.

1.3 AREA COVERAGE

The area covered (Fig. 1) is the southern Hawke’s Bay coastal catchment, extending from Herbertville and Cape Turnagain in the south to Kairākau in the north, ceasing some way into the northern catchment of the Ponui Stream. The area seldom extends more than 8 km inland with the exception of the Porangahau River catchment, which extends some 45 km inland. Herbertville is in the East Coast/Hawke’s Bay Conservancy of the Department, but in the local government Tararua District. The balance of the area is in the local government Central Hawke’s Bay District.

The hills are moderately steep sandstone, siltstone and limestone, rising to about 200 m a.s.l. in the survey area. A series of faults run parallel to the coast and about 2–5 km inland have produced a number of small valleys on their alignment (Lillie 1953). Hill soils are yellow-grey loams with high to moderate fertility (New Zealand Soil Bureau 1954) and the modern cover is, for the most part, pasture for sheep and cattle. The only large area of flat land is a strip of alluvium on the lower course of the Porangahau River, underlain by a fault, which grades into dunelands and Quaternary terraces over a strip extending some 20 km north to the Blackhead vicinity (Lillie 1953; New Zealand Geological Survey 1972). The strip is about 2 km wide and its inland edge is mostly composed of fans created by outwash from seasonally dry stream courses.

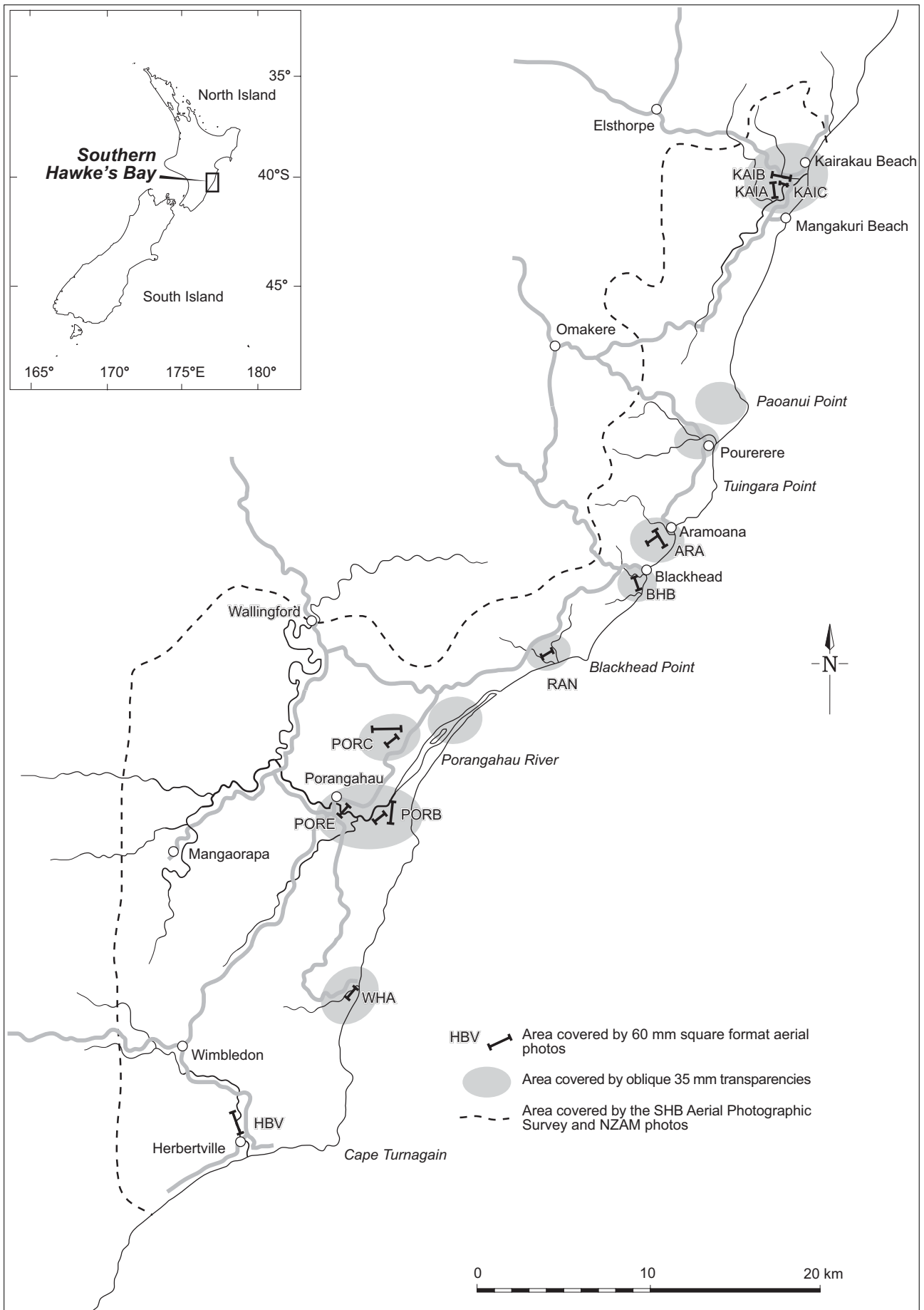
Previous archaeological work done in this district includes:

- Survey of whaling sites and possible Simcox sites by Nigel Prickett (1990, 2002)
- An excavation of a midden by Chris Arvidson near Rangitoto
- Mapping by Pam Bain (n.d.) of the pā Rangitoto
- Surveys by Mark Allen (1994, 1996) at Kairākau, his Manawarākau polity
- Survey by Robert Hunter (1993) at Te Apiti (just on the north of the survey area)

Prickett (1990) recorded a number of sites at Kairākau, Pourerere, Blackhead, Whangaehu and in the Porangahau dunes and Herbertville vicinity. One focus of

his work was to relocate sites from which the late John Simcox had collected in the 1920s and 30s. Remarkable artefacts from this collection period, together with notes and maps by Simcox, are held by the Hawke's Bay Cultural Trust. Because ours was an aerial survey, only some of the sites for which there are existing records have been re-photographed or re-recorded. Lillie's (1953) *Geology of the Dannevirke Subdivision* incorporates a number of geological maps (created in approximately 1940) which show middens and pits in the Porangahau and Rangitoto areas. The present study has recorded some of these, but others, especially in the truncated dunes around Beach Road, appear to have been destroyed.

Figure 1. Map of the area covered by the Southern Hawke's Bay aerial archaeology survey, showing the purpose-flown low-level vertical photograph runs (indicated by a bar and letters) and areas that have oblique photograph coverage.



2. Methodology

2.1 AERIAL PHOTOGRAPHY

Vertical aerial photographic coverage was selective and focused on areas where reconnaissance showed major sites or concentrations of sites (Fig. 1). Photographs were taken in two main phases: summer and winter.

On 4 February 1998 Kevin Jones flew with Associated Aviation to Herbertville, Porangahau and Blackhead. Photographs were in colour and the flight was carried out in the belief that cropmarks or parchmarks might show. These are phenomena that may indicate the presence of sites underground that are not otherwise able to be detected from the surface. Cropmarks are variations in the colour and light reflectance in crops. Parchmarks are changes in grass colour in various stages of drought (Wilson 2000: 67–87). As an example, the line of a buried ditch may show up as a line of different colour in the image of the crop or grass. The results from this flight were mixed. In some cases, very poor relief definition was perceptible with the stereoscope. However, some sites were clearly defined by parchmarks on their banks or other elevated surfaces, particularly on alluvium. A new record of a pā was made downstream from the Porangahau township. From this summer run, only the Herbertville photographs were used for the mapping phase of the project.

When taking stereophoto pairs, a site or complex of sites 300 m wide and more than 500 m long in one dimension is most effectively filmed along the longer axis. On this flight, we used aviation GPS to control the alignment of the aircraft for the photographic run. This was achieved by having two known waypoints aligned with the intended photographic run (Fig. 2A). The first waypoint was about 1 km from the site, and the second just outside the perimeter of the site. The two waypoints are aligned so as to give effective coverage of the site. A reading on the GPS gives the pilot the correct compass bearing on which to fly, and shows deviations from it, so that he or she can line up for the run. Using waypoints calculated from NZMS 260 grid references, we found that we were out of position by about 200 m on some runs. Aviation GPS (WGS 84) is 184 m or 6 seconds north of the International latitude convention, as used on NZMS 260. In future, the 6 seconds should be taken into account when entering waypoints in the aviation GPS unit. In the winter run we resorted to lining up the run by eye to get the plane correctly over the desired sites. From the passenger seat, the photographer looks forward to the site from about 3 km away, instructs the pilot on any changes to the approach (Fig. 2B), and then clambers into the rear of the aircraft about 20 seconds before the photographic sequence needs to be initiated. Therefore at a distance of about 1 km, the photographer is able to look down through the camera hatch and then the camera eyepiece, and makes any final adjustments to the approach, if possible. On some occasions, if the positioning is wrong, the camera is not triggered and the run made again.

Generally, the aerial photographic method was similar to that outlined in Jones (1999). The main camera used was a Bronica Sq Ai (electronic, 6 × 6 cm format negative) fitted with the standard motor drive. It was connected to a custom-

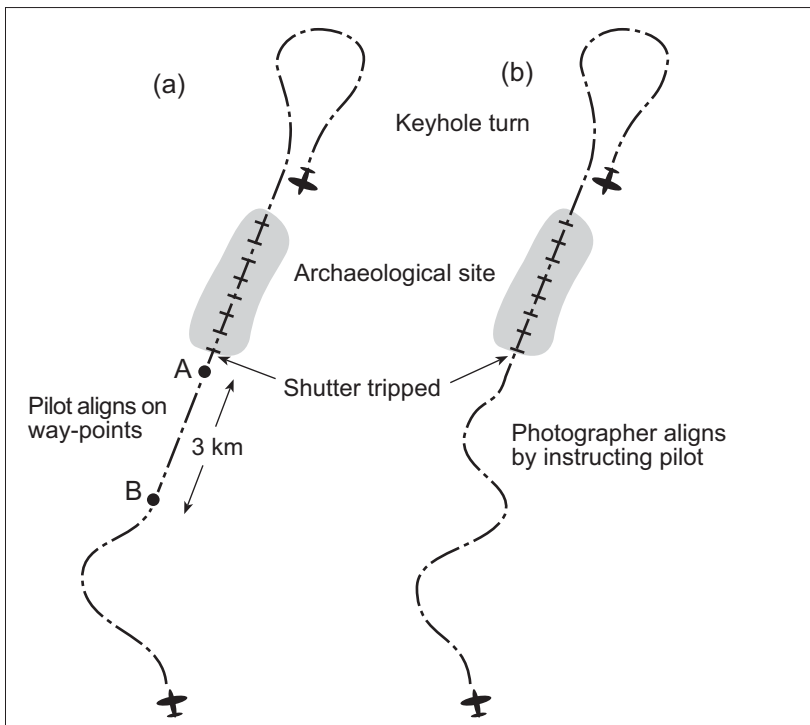


Figure 2. Two means of aligning the aircraft: (a) aviation GPS using waypoints, (b) aligning by eye.

pex sheet, and instructing the pilot via intercom.

An advantage of using 6 × 6 cm format film is that the negatives and proofs are spaced at the same distance apart (6 cm) as the pupils of the eyes. Hence, the contact proofs can be readily viewed with a pocket stereoscope. When the camera is mounted in the jig in the aircraft, it is essential that the film on the pressure plate inside the back of the camera winds forward in the same direction as the aircraft is flying. If it winds in the opposite direction, stereo pairs will not be formed on the contact proofs. For this reason, some cameras, such as the Sq Ai, have to be mounted on the forward edge of the jig (and appear 'upside down' to the photographer), and others, such as the Mamiya C330, on the rearward edge.

Winter photographs were taken at around midday on 16 June 1998. Relief shading in low-angle light was the main source of mapping data. Selected sites were photographed in Kairākau, Aramoana, Paoanui, Rangitoto, Black Head, Porangahau and Whangaehu districts. In all, 16 useable runs at 2800 feet altitude (approximate original scale 1:10 000) were achieved. The coverage of, and the index references for, the photographic runs are shown in Fig. 1.

A scan of conventional vertical aerial photographs held by Land Information New Zealand archives for the wider Porangahau catchment (an area of about 300 km²) was carried out. Sites that were not photographed in the small-format or oblique aerials were common on the hill country east of Porangahau. No sites were observed in the wider Porangahau catchment upstream of the town. A noteworthy feature of the early aerial photograph coverage is the Royal New Zealand Air Force (RNZAF) series 18 of 26 May 1937: frames Z/24-26 cover the Kairākau vicinity and Z/55-57 are in the Rangitoto vicinity. The index contact prints appear to show middens as well as the pā. Because of the cost of obtaining good prints, these photographs were not analysed further. There is no RNZAF coverage of the Porangahau vicinity.

made intervalometer, tested and trialled in the air on 4 February 1998. The intervalometer allowed fairly accurate 60% overlapping (or any other chosen percentage overlap) photographs to be taken. The aeroplane used was an Associated Aviation Ltd Cessna 205 fitted (for a conventional large aerial camera) with a circular floor hatch about 15 inches wide between the front seats and where the rear passenger seats are normally fitted. A camera mount was incorporated into a plywood and sheet-perspex jig and the whole assembly was bolted over the hatch. The cameras are mounted over holes in the perspex, with the photographer kneeling to the rear of the jig, sighting forward through the perspex

2.2 MAPPING

In preliminary setting of the objectives, accuracy standards for plan detail were set at $\pm 3\%$. Conventional camera vertical photographs should yield this level of accuracy in all but the steepest terrain. Relative elevations may also be determinable but acceptable errors were not determined and elevations (sections) through sites have not been drawn. Sketch plans were drawn from some oblique photographs for which there was no vertical coverage. One site record contains a sketch plan drawn on the ground while observing the control points.

Two types of map were drawn from the purpose-flown aerial photographs and the New Zealand Aerial Mapping Ltd vertical photographs. First, sketch maps were drawn from each of the purpose-flown photographic runs. These were drawn primarily as a site relocation tool to be filed with the New Zealand Archaeological Association site record forms. Some sites were also drawn in detail by directly tracing or sketching off conventional vertical aerial photographs following the methods outlined in Jones (1999).

Second, the purpose-flown aerial photographic runs were used to map the features of individual sites in detail. Depending on the nature of the site, these maps were then enlarged and redrawn in ink, allowing the depiction of greater detail. Detailed site maps were drawn using a mirror stereoscope with $3\times$ magnification lenses (model: Wild Heerbrugg type 369275, Switzerland). This machine allows the relief of the site to be observed. Maps were drawn with the stereoscope either directly from the photographs or from enlarged laser photocopies onto Permatrace paper, using a pencil (Fig. 3). This model of mirror stereoscope is fitted with a parallax bar, a 'metal bar with a graduated metric scale and glass plates at each end' (Warner et al. 1996: 53-55). The glass plates have symbols on them and appear as shown below:

Figure 3. An illustration of the use of mirror stereoscope. Model: Wild Heerbrugg Type 369275 Switzerland.

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The parallax bar is adjusted so that these symbols appear to fuse, and must then be lowered so that they appear to be touching the ground on the stereo image. At this stage, a plan may be made which takes into account the distortions inherent in each of the two photographs. The stereoscope used in this project was fitted with a moveable plotting table with a pencil. Moving the plotting table, so that the fused dot traces around the image, produces the map. The stereoscope was not used to map from the New Zealand Aerial Mapping photographs, since these were at a scale too small to show the features adequately, or to draw in the detail of features that did show.

The scales at which the maps were drawn varied slightly between photographic runs. Scales were determined by calculating the distance between GPS control points recognisable in the photograph, taking the square root of the sum of the squares of the differences between the coordinates for two points. In some cases, the distances between three points were calculated to check for photo distortion. Differences in scale between the three points were minimal, except in one case where the points greatly differed in elevation. Where there was no GPS measurement for a site, the scale was determined from known features using the NZMS 260 map series, or tape and compass control points measured in the field. The north orientation and map grid position of selected sites were also determined from the differential GPS survey of control point. Appendix 1 contains further details of the GPS fieldwork and control methods used in the present survey.

The small-format photographs were taken on runs that were chosen to give efficient coverage of the sites, and not on an east-west orientation such as used for conventional aerial photographs. Photograph orientation was determined by taking the tangent of the angle formed by a nominal east-west line through one control point (A) and the line formed between the coordinates of two control points (one of which was A). For the winter photographs, the true north orientation could be checked against the orientation of shadows cast by the sun on more or less level ground. NZMS 260 maps and conventional vertical aerial photographs were used as minor aids to determine orientation.

3. Archaeological survey results

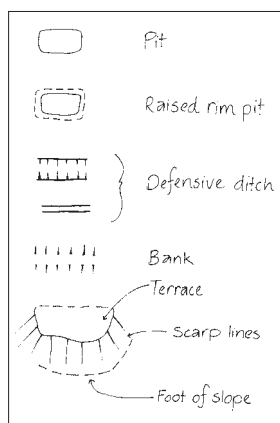
The thematic map (Fig. 4) of the project area shows the distribution of pā, pit concentrations and the approximate margin of pre-European settlement. The distribution of sites follows the coastline in areas where the coast is accessible by easy canoe landings, notably in the small, relatively sheltered bays such as Whangaehu or Blackhead Beach. Sites are also distributed along the major rivers, particularly the Porangahau (see Fig. 4 detail) and the Mangakuri Rivers. In some areas, sites are up to 5 or 6 km inland, particularly at Porangahau, with lowland sites between meanders of the Porangahau River. At Porangahau too, access for settlement has been gained from the lower reaches of the river across truncated dunes and colluvial fans to the hill country. Many sites in these dunelands are probably unrecorded.

Many pits are recorded at Whangaehu, Porangahau and Kairākau. Pits are up to 6 km inland at Porangahau, mainly because it is a large river valley, while at the smaller valleys of Whangaehu and Kairākau they are up to 3 km inland. The most extensive concentration of pits in the Porangahau catchment is on the northern side of the river. The two greatest concentrations of pā are at Porangahau and Kairākau; the latter is Allen's (1994) Manawarākau polity, an area with a single paramount chief. They are placed on the hills overlooking the Mangakuri River gorge, and as much as 5.5 km upstream. In contrast, at Porangahau, there are two remarkable pā on river bends, both with storage pits, and further pā on ridgelines overlooking the lower river.

Most of the site maps were drawn from the 13 purpose-flown aerial photographic runs taken on 4 February and 16 June 1998. In total, 109 new sites were recorded, 79 of which were mapped in detail. The remaining 30 were observed on conventional aerial photographs at a scale too small to obtain enough detail to warrant mapping. A further 15 sites were re-recorded, and mapped or remapped. A list of sites is given in Appendix 2, and the following chapter contains a description of some of them.

Six pā were recorded for the first time with the NZAA site recording scheme. Nine previously unrecorded historic sites have now been recorded, six of which are ditch and bank fences. The majority of the sites recorded for the first time were storage pits, totalling 73 (including four raised-rim pit sites). One of the more unusual observations was site V24/99 (Fig. 4 detail), a number of possible ovens. These were evident on the aerial photographs as black circular patches visible in a ploughed field.

Key for line drawings in
Figs 5-23.



Seaward of the modern township of Porangahau, some important discoveries were made on the alluvial fan of the river which has (or had) a number of meanders and broad points. Two of these points have major pā (V24/95 and V24/121). The latter was recorded from conventional aerial photographs and it is thought that its surface features are now ploughed down. Buchanan (1973) gave a plan of the Porangahau area showing a number of named settlements on either side of the river below the present township. Owing to the small scale (i.e. imprecision) of this plan, we could not relate any of these names to the sites described below. Nor is it possible to relocate places mentioned by Ballara (1995: 17) in her account of social organisation in the eighteenth century in Porangahau. It is recommended that tangata whenua be approached for assistance on relocating the sites which relate to these place names.

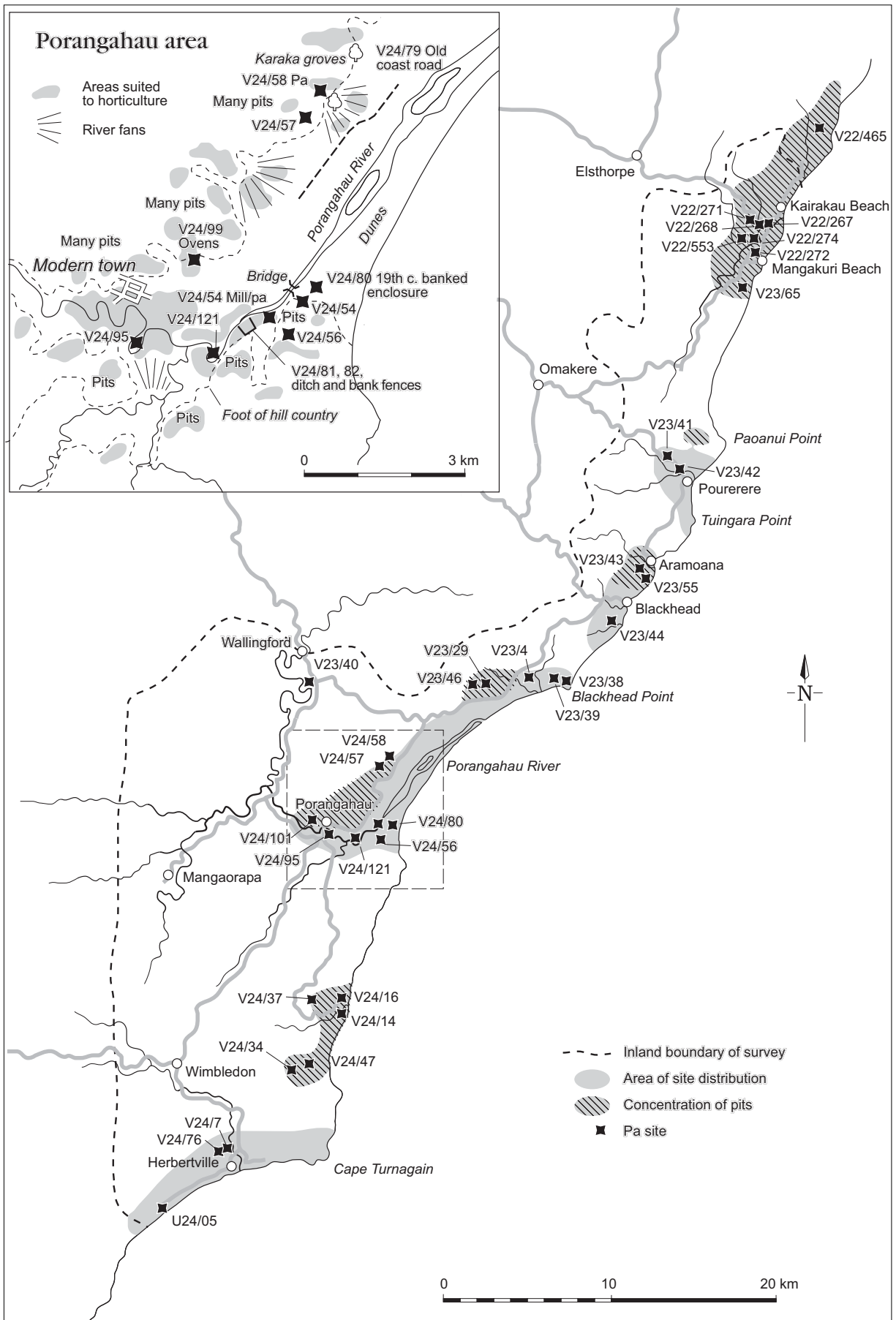


Figure 4. Map of site concentrations and distribution in the area surveyed in the Southern Hawke's Bay aerial archaeology survey.

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