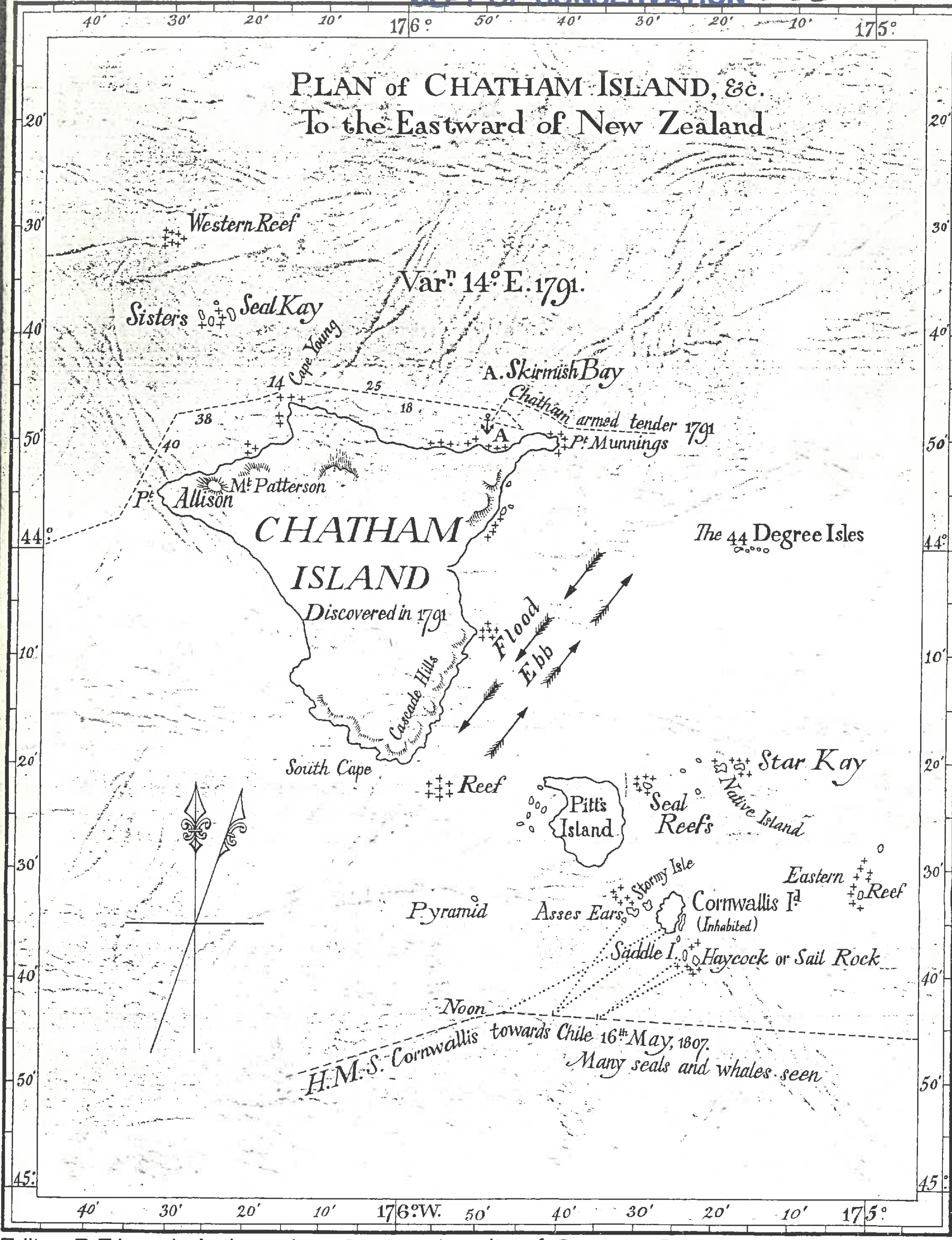
WORKING PAPERS IN CHATHAM ISLANDS ARCHAEOLOGY



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Working Papers in Chatham Islands Archaeology 6.

Vegetation and Archaeology on Chatham Island

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Earlier papers in the series are:

1. Smith, I.W.G. and P. Wernham
"Survey of Archaeological Sites: Te Awapatiki to Hapupu, Hanson Bay, Chathams Island." 1976.

2. Weiss, Dr.B. (translated K.J. Dennison)
"More than Fifty Years on Chatham Island". 1976.

3. Park, G.S.
"The Dendroglyphs and Petroglyphs of the Chatham Islands". 1976.

4. Houghton, P.
"The Human Skeletal Material from Waihora (CH283)". 1976.

5. Sutton, D.G.
"An Alternative Research Strategy for the Study of Prehistoric Human Skeletal Remains". 1977.

Foreword

It is now commonplace to believe that the reconstruction of vegetation surrounding archaeological sites ought to be a high priority on the endless list of tasks confronting the research archaeologist. While the benefits are often discussed, if somewhat generally, there is much less comment in the literature about the costs and problems involved. However, the mechanics of getting a suitable reconstruction of vegetation from the field evidence can be very complicated. The necessary techniques are often beyond the experience of the archaeologist who then asks questions of another expert in terms which are quite foreign to the discipline in which the research must be conducted. The technical problems are substantial but the articulation of results drawn from different disciplines may be the central problem in multi-disciplinary research.

The latter stages of the Chathams Project were interesting in this respect. As our fieldwork interests concentrated on the area around Point Durham specific problems about environmental history emerged. The reconstruction of a detailed vegetation pattern for the period around the fifteenth century A.D. was the principal amongst these. We were able to approach this problem through several independent avenues.

These were Jill Hamel's ecological survey of contemporary vegetation which is reported in this number of Working Papers, a pollen sequence from peat sections near the Waihora Mound Site being compiled by Dr. John Dodson, historical information on vegetation at the time of European land clearance collected by Sally Begg in her research on the history of the Otonga Land Block and Rod Wallace's study of the feasibility of reconstructing vegetation on the basis of land snail assemblages recovered from archaeological sites.

At first glance we might be accused of duplication of effort. However, the reward for the additional work is a chance to apply a range of independent methods and observe the advantages of each in relation to an archaeological frame of reference. I submit that this may be one of the most important results of the Chathams research. I am very pleased to continue the Working Papers with this number. Other aspects of the work on vegetation will be reported as they approach completion.

D.G. Sutton,
Acting Editor.

VEGETATION AND ARCHAEOLOGY ON CHATHAM ISLAND

Jill Hamel

INTRODUCTION

During the past decade there has been a growing interest in the investigation of regional prehistories in New Zealand. This has developed out of and is parallel to world wide interest in archaeo-environmental studies, which have affected the objectives of regional studies in this country. "Whereas earlier regional studies appear to have had a 'sequence' as a prime objective, future programmes should aim to first reconstruct community activities in their ecological context and only later undertake a study of evolutionary development" (Leach 1976:24). Leach wrote this in discussing his regional study of the Wairarapa but it clearly indicates one of the objectives of the Chatham Islands Archaeological Expedition as planned by him, and other Otago archaeologists. As part of the process of reconstructing the 'ecological context' I was given the task of investigating the botanical ecology of Chatham Island, with a view to:

a. Determining which major species were best adapted to the terrain surrounding the archaeological sites being investigated, particularly those of the south west coast.

b. Defining short term changes in the vegetation due to the impact of European activities.

c. Interpreting long term changes in the vegetation as indicated by the analysis of land snail species, charcoals, subfossil woods, pollens and plant macrofossils taken from profiles in and around the excavated sites.

With these objectives in view a study was undertaken to examine natural successions and the distribution of the major plant communities, and to determine the gross responses of common Chatham Island tree species to climatic and edaphic factors. The possible successions in the past vegetation can in part be inferred from present day seral stages where the vegetation has been disturbed. The tolerances of different tree species to variations in the physical environment often help to explain the course of these succcessions and the pattern of present vegetation.

There are few ecological descriptions of Chatham Island vegetation. Most observers in the 19th century were concerned with taxonomy and gave little information on habitat and distribution of species, e.g. Mueller 1864, Buchanan 1875, The most useful discussion is that of Cockayne (1901) in which he provides a detailed classification of the plant communities of Chatham Island as he saw them but says little about their extent. No major botanical survey has been published since then. Wright (1959) attempted a reconstruction of the prehistoric vegetation based on the distribution of soil types. Richards (1962) in a wide-ranging "historical geography" combined Wright's and Cockayne's material in elaborate reconstructions of the vegetation (a) immediately prior to the arrival of man, (b) at the time of Cockayne's visit in 1901, and (c) at the time of his own study in 1961. However the means by which he determined the vegetation boundaries on his maps are not stated. Ritchie (1970) and Kelly (1971) both assessed the deterioration of native plant communities to determine requirements for reservations.

METHODS

Four different types of research were designed to provide information on the past history and structure of the Chathams vegetation. Analyses of pollen by Dr. J. Dodson, Canterbury University, will provide material on long term changes. A correlation of modern land snails and vegetation by P. Cresswell, R. Wallace and J. Hamel, Otago University, in the form described in Leach (1976:120) will provide a means of interpreting the past environments from which the archaeological land snails were derived. Accounts of earlier historic vegetation collected by S. Begg, Otago University, may demonstrate the effects of European activities on the distribution of Chathams forests. An ecological survey of the present vegetation is basic to interpreting the results from these other lines of research.

The modern vegetation is highly disturbed as it has been grazed throughout the whole island by domestic stock for over a century. Large areas of the better drained soils, which were previously in forest, have been converted to introduced pasture by ploughing and grazing. The less palatable species such as Mysrine chathamica will have increased in abundance. These factors were taken into account when selecting areas of forest, shrubland and bog for examination. A survey using quadrat sampling and reconnaisance methods was made, extending along the south west coast from the Horns to Waitangi, from Waitangi and the northern edge of the tableland to Tennant's Lake and from Ocean Mail Beach east and south to Lake Kaingarahu. (Fig.1). The block of land to the west of Wharekauri, the areas around Owenga and most of the southern tableland were omitted due to shortage of time and difficulties of transport. Shoreline vegetation was examined on the low rocky shore near Point Durham and Waitangi and on the sand dunes of Petre Bay and Ocean Mail Point. Though the vegetation of the island overall was considered, attention was focussed on the south west coast where most of the archaeological excavations have been carried out.

In the course of this survey, notes were made on the species seen , their associations and relative abundance, the nature of the soil, the slope and aspect of the ground, the degree of shelter, signs of regeneration, heights of canopies, the nature of the understory and the effects of fire, stock and exposure to wind. Specimens were collected for the Botany Department herbarium, University of Otago and wood samples were taken for Dr. B. Molloy, Botany Division, D.S.I.R. Quadrats were placed within forest stands and on salt marsh turf in conjunction with the survey of modern snail distribution carried out by P. Cresswell. This quadrat data was a useful supplement to the reconnaisance work but it could not be designed to form the basis of a vegetation analysis, because of the need to integrate it with the snail survey.

TOPOGRAPHY

Chatham Island has a low profile, an irregular outline and a large central lagoon. No part of ~~the island~~ is more than 10 kilometres from the sea and the level sky lines are broken only by a few volcanic, cone-shaped hills.

Geologically and topographically the island can be divided into three zones. North of the lagoon is a smoothly undulating, peat-covered plain, with extensive bogs lying on consolidated sands over schist rocks which outcrop along the coast. Small lakes and about nine volcanic hills break the surface of this plain. The centre of the island is occupied by Te Whanga lagoon and Lake Huro, with narrow strips of land dividing them from each other and the sea. On the western side Te Whanga is edged by vertical limestone cliffs less than 15 metres high. The southern rectangular tableland rises smoothly from Te Whanga to the 245-275 metre cliffs along the southern coast. The table-land is dissected by steep-sided winding gullies, but there are large areas of poorly drained swampland on the flat-topped ridges and plateaus. Peat and peat soils occupy 59% of the land surface, and volcanic soils, the second most important type, occupy 16%, mostly around Waitangi and along the south west coast (Wright 1959).

CLIMATE

To human beings the Chathams seems a wet island, as the rainfall is evenly spread throughout the year and rain days are numerous, an average of 183 per year over 68 years of recording. The mean annual rainfall is however quite low, 840mm (33.7 in) per year. Moreover, "dry spells (i.e. less than 0.04 in (1mm) on each of at least 15 consecutive days) can be expected to occur almost every year and may occur two or even three times in a single year. Dry spells sometimes last for more than a month" (Wright 1959:20). Temperatures are equable throughout the year and the mean annual value of 11.0°C (51.6°F) is relatively low, as would be expected on such an oceanic island. Official values for humidity are high, with a daily mean range of 80-87%, but winds tend to be constant and steady with few gales but also few calm days. Windspeed averages of 10 knots in the morning and 18 knots in the afternoon have been recorded at the Meteorological Station, Waitangi. These climate records are taken from Richards (1962), and are all for Waitangi. The range of variation over the island is not known but the inhabitants consider that the southern tableland is more foggy, wetter and windier than the northern area.

MAJOR VEGETATION TYPES

In assessing the effects of topography and climate on the Chathams vegetation, it is necessary to consider several variables in conjunction as no one has a predominant influence. The rainfall of 800mm, combined with the low temperatures is adequate for forest growth throughout the island. Combined with the steady winds and frequency of dry spells this rainfall seems to be insufficient for regeneration on slopes exposed to the west once the forest is disturbed by grazing, fire or opening of the canopy by tree felling.

High sand dunes, the Te Whanga limestone cliffs and gullies in the tableland all create microclimates sheltered from the prevailing winds, and in these the forest shows the immediate response of increased height and increase in numbers of tree species. However, water-logged soils which cannot support tree growth are also common. At present the well-drained soils on the slopes of gullies in the tableland carry the richest of the tableland forests, but the boggy soils in the bottoms of the gullies, though sheltered, often have only species tolerant of water logging such as the local tree coprosma (Coprosoma chathamica) and tree ferns (Dicksonia squarrosa and D.fibrosa.).

The following descriptions of the present forest system largely ignore the effects of recent farming. Minor changes in slope and aspect are so effective in creating micro-climates on Chatham Island that there can be a wide range of variation in the height and structure of the vegetation over very short distances, but it is still possible to make some generalizations about differences between major forest types. Cockayne (1901) distinguished 27 different assemblages or formations of plants on Chathams Island, using sometimes a dominant species, e.g. Olearia chathamica, and sometimes the terrain, e.g. rocky shore to characterize the formation. Many of his herb and shrubland formations would now be described as transitional or successional stages. His forest categories were 'Lowland' and 'Limestone' for the northern half of the island and 'Tableland' for the southern half. He also separated out the forest developed on Te Awatapu on the southern coast where low altitude and shelter from the south west winds have allowed ribbonwood (Plagianthus betulinus), tutu (Coriaria arborea) and pepper tree (Macro-piper excelsum), which are typically northern and lowland species, to enter an otherwise southern tableland forest.

Other vegetation types which are of interest to the prehistorian are the shrublands which now grade into bracken heaths on the drier ridges and into reed, flax and sedge swamps on the flatter wetter ground. Altitude, soil conditions and exposure to wind on the flat ~~spurs~~ at present inhibit invasion of bracken-shrublands by forest from remnants in the gullies, but whether or not intermittent fire is required to prevent long term invasion cannot be deduced from observation. Proof of the presence of log remains from some of the highest, most exposed and relatively boggy spurs and their dating could resolve this problem.

Chathams vegetation is here considered under the following headings:

A. Shoreline vegetation

B. Heaths and boglands

C. 1. Lowland forests of the northern and middle region

 2. Mixed broadleaved forests of the southern region

 3. Dracophyllum forest.

Cockayne's "Limestone forests" are so limited in extent that they are combined in this classification with the other lowland forests, but it was considered worthwhile to divide his "Tableland forests" into the Mixed broadleaved forests of the coast and deep gullies and the Dracophyllum forests of the ridges and plateaux. Wright (1959) and Kelly (1971) also distinguish a mixed broadleaved forest type but include within it different parts of the northern lowland forests.

SHORELINE VEGETATION

Excluding the cliff shrublands, the vegetation of the shoreline varies from tall annuals and grassy plants with scattered shrubs among boulders and sand dunes to level peaty areas of saltmarsh turf, with transitional vegetation extending from the shore into the adjacent forest or bogland. These shoreline associations form the most opportunistic, ephemeral and modified vegetation on the island, and the specification of natural assemblages is difficult. The long term presence of a particular species somwhere along the low rocky or sandy shorelines is all that can be postulated from present day observations and those of Cockayne. These postulations depend on the constant 'processing' of the shoreline by wave action, such that favourable habitat for each species is present most of the time somewhere along the shore. A particular mix of boulders and gravel favouring the growth of the native sowthistle (Sonchus grandifolius) may not have been present in a given area for the past 1000 years, but it was likely to have been present somewhere within a few miles of that area throughout the prehistoric period.

A transect from a present day rocky shore into the sand dunes of the northern half of the island might pass across salt-marsh turf, then a boulder zone with scattered bush nettle (Urtica australis), daisy family weeds, some succulent species and native spinach (Tetragonia sp) into sand dunes now consolidated by introduced marram grass (Ammophila arenaria). Prior to grazing, the native forget-me-not (Myosotidium hortensia) was likely to have occurred among the boulders. In the sand dunes among the marram grass there may be native plants such as the sand binding sedge (Scirpus nodosus), native convolvulus (Calystegia soldanella), fescue (Festuca littoralis) and low shrubs with fine hard leaves (Pimelea arenaria, Cyathodes parviflora and Coprosma acerosa) with occasional trees of Olearia traversi. In hollows of the dunes and in the shelter of the back dune, low forest begins with a wind-sheared canopy curving up from the slope of the dune. The forest is usually karaka (Corynocarpus laevigata) with the browse-and wind-resistant tree-myrsine (Myrsine chathamica) sealing the edges.

The archaeologically interesting species of the shoreline are the edible ones, including sowthistle, native spinach, native celery (Apium australe), iceplant (Disphyma australe), Asplenium spp and a fat-hen like plant Chenopodium ambiguum. These are edible in the sense that they are included in the ethnographic literature as having been eaten by the New Zealand Maoris, and at least the first three are palatable to Europeans. The other shoreline species of interest is the bush nettle which could have shaded out the edible species and even prevented the use of the shoreline since it has very effective stinging [illegible]irs. At present it is confined to boulder banks and rocky shores with stones more than about 30 cm across. This may be because the young shoots and rootstock require the protection of large boulders against trampling by stock. On the other hand the rootstock may require protection from desiccation, a factor operating during the prehistoric as well as at present.

HEATHS AND BOGLANDS

These two are placed together because reed-like plants are common in both, plant heights are similar and they often occur together in a fine mosaic on flat to undulating ground. In the shrubby boglands of the northern area, such as those to the east of Te Whanga lagoon, two low shrubs with small hard leaves (Dracophyllum paludosum and Cyathodes robusta) dominate, interspersed with patches of stunted bracken heath in the drier places and stands of jointed rush (Leptocarpus similis) and various reed-like plants in wetter ground. Though botanically a rich community there are few if any edible plants in the boglands proper. Their main value to prehistoric man would have been as a source of thatching material, particularly of the jointed rush which is relatively durable.

Cockayne (1901) differentiated the shrubby boglands of the tableland by their dominant species, e.g. Sporodanthus (Lepyrodia)-Olearia semidentata bogs, Olearia-Dracophyllum paludosum bogs and Phormium bogs, but did not describe the extent of each formation. Kelly (1971) reported that Sporadanthus bog covers 7,285 hectares (18,000 acres). He considers that this type of bog 'was one of the four original major vegetation types of main Chatham - and formed "the clears" in contrast to the forests' (Kelly, 1971:28).

Stunted bracken is common throughout all bogs and on fire-induced heaths of both flats and ridges. During the prehistoric period the most productive bracken in terms of rhizome production would have grown in reasonably well-drained soils on the northern foothills of the tableland or on the back dune slopes of Petre Bay. Bracken is a seral community and, like the shoreline communities, opportunistic and ephemeral in the absence of fire.

LOWLAND FORESTS OF THE NORTHERN AND MIDDLE REGIONS

The distinctive trees of these forests are karaka and nikau palm, which are generally absent from the tableland forests, along with abundant tree-coprosma (Coprosma chathamica) and tree-myrsine. At present nikaus are sparsely but widely distributed and there is no evidence that there were ever extensive groves of them. Karaka is the widespread and tallest tree of all the forests on drier ground, rivalled only by ribbonwood (Plagianthus betulinus) on limestone country. Many of the karaka forests contain only mature individuals and are very open underneath, the dense canopy and repressive litter of large leaves contributing to this effect. Stock-grazing however has further depleted the understory. In part of the Henga forest which had been previously heavily grazed but was only lightly grazed in the summer prior to the survey, 10 cm seedlings of karaka, tree-coprosma, tree-myrsine and Hymenanthera chathamica were relatively common. In exclosures lining each side of Hapupu airfield, a later stage of regeneration had been reached, and there were a few young saplings of Hymenanthera and tree-myrsine, 1-3 metres high, under 5 metre high karakas. An understory was also developing from coppice shoots especially of tree-coprosma. Most of the Chatham tree species coppice to some extent, even karaka, when released from grazing. It could be assumed that a partially cleared living area of prehistoric man, set within lowland forest, would regenerate readily through coppicing and seedling establishment within a few decades. Regeneration may not, however, be directly to a forest of the same composition as before. It was noticeable at Henga and Hapupu that, though Hymenanthera trees were relatively few in the canopy, their seedlings were the most abundant on the forest floor. It is a small fast-growing tree and presumably would form an intermediate stage in forest regeneration, eventually being overtopped and reduced in numbers by tree-coprosma, tree-myrsine and karaka. Hymenanthera seeds could form a useful marker of abandonment of lowland occupation sites.

Within lowland forests different tree species have competitive advantages under particular conditions. Akeake (Olearia traversi)can germinate in full sunlight in exposed conditions but the seedling will not tolerate shading. Hence the species occurs within forests only close to forest margins or in steep gullies where irregularities of the ground have allowed light through to ground level. It is common as lone trees standing in introduced pasture where it may have established among the dead trunks of other species killed by farming activities. Akeake is typical of transitional or ecotonal stands and is found along both the sand dune edges and lake margins of the lowland forests. On the flat boggy ground around Lake Huro it is associated with tree-coprosma. Akeake may be typified as tolerant of a wide range of soil types, more tolerant than the other tree species of wind and salt spray, but it is denied a permanent position within the forests by its inability to germinate under a closed canopy.

Tree-myrsine is second to akeake in tolerance to exposure but requires a fairly well-drained soil. Tree-coprosma requires sheltered conditions but tolerates wet soils and so can replace tree-myrsine on extensive areas of flat to rolling boggy soils which are just dry enough for forest growth. These two species are widely distributed in the lowland forests and in the mixed broadleaved forests around the tableland.

Karaka is even less tolerant of 'wet feet' than tree-myrsine and also requires more shelter. From general observation it appeared that karaka seedlings can establish only under a closed canopy with ground-level shelter from wind, such as in the Henga forests behind high sand dunes. Mature trees are readily killed if destruction of the forest edge allows the wind in under the canopy. In the tableland forests karaka was seen only in the north-flowing river valleys such as the Nairn and in a very sheltered corner of Awatotara Creek. Its absence from even the well-drained soils of the tableland may be due to a combination of exposure to wind and slightly lower temperatures. For the Morioris the karaka with its edible fruits would have been the most valuable species of these lowland forests. The berries of all the coprosmas are edible and some other species such as nikaus could have provided occasional 'greens'.

MIXED BROADLEAVED FORESTS OF THE SOUTHERN REGION

This type of forest occurs in the gullies and on the lower slopes of the tableland. Its distinctive species are a tree senecio (Senecio huntii), two tree ferns (Dicksonia squarrosa and D.fibrosa), Pseudopanax chathamica and tarahinau (Dracophyllum arboreum), with abundant tree-myrsine and tree-coprosma. Akeake is common along forest margins and as lone trees in clearings. The understory is much denser than in the lowland forests and epiphytic ferns and bryophytes extend high up trunks and branches. Forest composition varies greatly according to slope, aspect and shelter. Sheltered wet gullies may contain pure stands of tree ferns with occasional tree-coprosmas. Exposed south-facing slopes are occupied by tarahinau which increases in frequency with altitude and is the common tree of the inland tableland forests. The coastal edges contain distinctive species such as a tree hebe (Hebe barkeri) and a large flowered olearia (Olearia chathamica). The latter has distinct competitive advantages on less boggy soils, fully exposed to salt spray on cliff faces, and is abundant with Phormium tenax on the cliffs of the south coast (Cockayne 1901). It is uncommon elsewhere and I saw it only on the Horns. A few species such as coprosmas, lawyer (Rubus cissoides) and ferns would have provided some edible fruits and "greens" but in general the plant foods of this and the following forest type would have been sparse.

DRACOPHYLLUM FOREST

This occupies

"one large, reasonably continuous block running from Pipitarawai southward towards the Horns, and totalling some 8,500 acres (3,440 hectares). There are smaller patches scattered over the southern tablelands, lining watercourses and changes of topography between the undulating bogs" of *Sporadanthus*, *Olearia semidentata* and *Dracophyllum paludosum* (Kelly 1971:28). These forests contain few other trees than tarahinau with an understory of *Dicksonia squarrosa*.

Wright (1959) showed tarahinau to be the principal peat-forming species on Chatham Island and considered that the areas now covered by peat and peat soils carried a "Broadleaved/ *Dracophyllum* Transition forest" prior to burning by man. He also found evidence in soil profiles that *Dracophyllum* may replace broad leaved forest by "conditioning" the soil through podosolization and eventual pan formation. In the acid waterlogged conditions of the resulting perched watertable, *Dracophyllum* seems to have competitive advantage over broad leaved species.

FOREST DISTRIBUTION ABOUT 1800 A.D.

In 1840 Dieffenbach (1841) produced a description of the Chathams intended to encourage European settlement. He sailed round the island and walked across country at least at Kaingaroa, Port Hutt and near Waitangi. His description of the vegetation is the most complete for the early nineteenth century and can be used to provide an outline of the gross physiognomy of the vegetation at the time of European contact. He described the northern, eastern and western coasts north of Waitangi as backed by "low wooded hills". On the northern coasts the sandhills were wooded for only a short distance inland and most of the north-western block of the island was "undulating boggy moor" as it is today. The volcanic hills of the northern block were oases of trees and ferns in the surrounding bog, a pattern which is obvious from the present relict vegetation. To the east around Kaingaroa and the north-east promontory the low hills were wooded, but Te Whanga lagoon Dieffenbach described as surrounded by low hills which were either wooded or boggy. South from a line joining the opening of the lagoon and Te One was generally wooded up on to the tableland.

Dieffenbach's description of the tableland is inadequate. He wrote that the part of the island "to the southward of Waitangi Harbour... has an undulating surface, is not so boggy as the rest, and is either covered with an open forest of moderate sized trees, or with high fern" (Dieffenbach 1841:204). The Sporadanthus bogs of the southern tableland are of course relatively wet (Cockayne 1901:286), and it is only in sheltered gullies that bracken grows to more than about 30 cm high. Dieffenbach's description probably applied to only the northern and western edges of the tablelands.

In general Dieffenbach's account fits with the pattern that can be deduced from the modern vegetation. The overall pattern was one of a forested island with forest absent only where the ground was too water logged for even tree-coprosma or tarahinau to grow. The present undulating topography of both the lowlands and the tablelands suggests that there would have been a changing mosaic of forests and bog shrublands over recent millenia, with forest predominating except in the <u>Sporadanthus-Olearia</u> bogs of the southern tableland.

<u>Archaeology and vegetation of the south west coast</u>

The area on Chatham Island of most archaeological interest at present is the south west coast from Waitangi to Awatotara. The terrain is of moderate relief but generally exposed to the prevailing westerly winds. There are some sheltered gullies and bays north of Point Durham but around and to the south of the Point there is an exposed coastal terrace, one to two kilometres deep which was a major focus of prehistoric occupation. This terrace is divided into three swampy basins by low ridges and is backed by steeper spurs rising to the tableland proper. The coastal edge of the terrace consists of consolidated beach ridges with occasional rocky or sandy knolls standing 100 to 300 metres back from the shore. The shoreline alternates between rock platforms and steep boulder beaches.

The only south west coast excavations which do not lie on this terrace are those of McIlwraith's in three shoreline middens at Pokiakio, Ohinemamao and Te Ngaio (McIlwraith 1976). All the other excavated sites lie on the Point Durham coastal terrace. The Waihora Mound site which has been extensively excavated, lies on a sandy knoll two kilometres south of Point Durham and includes midden areas, houses and burials (Sutton: in prep., Nugent 1976). Smith (1976) has excavated a seal bone midden north of Waihora. Two small middens (CHA and CHB) on a low spur rising to the tableland north east of Waihora, have been excavated by Sutton (in prep.). Over eighty archaeological sites have been found along the shoreline, on the low dividing ridges and on the swamp margins of this terrace (Sutton: pers. comm. 1976).

From my ecological survey it is possible to make a preliminary reconstruction of the vegetation of the coastal strip. It is not profitable to build such a reconstruction in terms of closely defined species groupings or associations as formulated by Cockayne (1901). As argued in an ecological survey of Tiwai Point, the synecological approach can be misleading (Hamel 1969:155). For the purposes of describing the vegetation of Chatham Island in this survey, broad classificatory groupings were used, but even these should be recognised as loosely-defined, descriptive abstractions rather than 'real' entities. In reconstructing past vegetation, it is more revealing to use the individualistic distributions of species according to their tolerances and competitive advantages, which in this case have been estimated from their distribution in the modern vegetation.

In the broader terms of this survey, the coastal strip from Waitangi to Awatotara is suited to mixed broad-leaved forest, grading altitudinally into *Dracophyllum* forest on the higher ridges, two to three kilometres inland. The mixed forest of the coast is likely to have contained tree-myrsine, tree-coprosma, *Pseudopanax chathamica*, *Dicksonia squarrosa*, *D.fibrosa* and, along the stream edges, *Corokia macrocarpa*. On sheltered slopes and particularly in gullies, there may have been karaka, *Macropiper excelsa* and *Hymenanthera chathamica*. On the coastal terrace south of Point Durham, the drier ridges could have generally supported a low forest of tree-coprosma and tree-myrsine with an understory of tree ferns. The basins may have sometimes been too waterlogged for a closed forest, in which case akeake seedlings would have been able to establish. Any damage to this forest from fire or tree felling, combined with the exposure to south west winds would have allowed akeake to enter. The swampy basins may have carried a bog-shrubland at some time in their history of such species as *Juncus* spp, *Leptocarpus similis* and *Dracophyllum paludosum*. It is not apparent from this survey or from the literature whether or not the major swamp species of the tableland, *Sporadanthus traversi* and *Olearia semidentata*, would have tolerated the levels of salt spray likely to prevail on this terrace. Since karaka does occur further south, it could well have grown on the sheltered slopes of the ridges crossing the terrace. Along the rocky parts of the coastline, wherever there was sharper drainage, there may have been other small tree species such as *Olearia chathamica* and *Hebe barkeri* on the forest margin. Forest on well drained spurs and knolls would have been vulnerable to replacement after burning by a heath of stunted bracken and low shrubs of *Cyathodes robusta* and *Dracophyllum paludosum*.

European farming has converted the coastal strip to a mosaic of introduced pasture on the ploughable flatter ground, with bracken heath on the steeper spurs and a low broadleaved forest mostly confined to the gullies. Any bog vegetation that may have been present, has been ~~destroyed~~ by drainage and conversion to pasture. Pre-European fires presumably began the process of removing the forest and on this exposed coastline were probably very effective. Since the soil is a cohesive peat loam and the relief is moderate, deforestation does not cause erosion in this region. It is improbable that pre-European removal of the forest would have significantly increased the sediment load delivered into the coastal waters.

The proposals in this paper on the nature of the prehistoric vegetation and its recent history along the south west coast have been derived only from the survey of the modern vegetation. The reconstruction for the south west coast is preliminary in the sense that other types of independent data are being accumulated which will provide more direct evidence on past events. The relationships between these different sorts of data are complex. Patterns of plant distribution derived from the land snail surveys, charcoal identification, archival research and pollen analyses will require interpretation in the light of present day responses of the various species to climatic and edaphic factors. Thus the principles on which my reconstruction is based are of primary importance, but the actual proposals on where particular species could have occurred will be reconsidered in the light of more direct evidence from the other research projects. These latter will give substance and detail to an otherwise general and hypothetical scheme.

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PLANT SPECIES MENTIONED IN TEXT.

Ammophila arenaria	marram grass (introduced)
Apium australe	native celery
Asplenium spp	ferns
Calystegia soldanella	native convolvulus
Chenopodium ambiguum	fat-hen like plant
Coprosma acerosa	small-leaved creeping coprosma
Coprosma chathamica	tree coprosma
Coriaria arborea	tutu
Corynocarpus laevigata	karaka
Cyathodes parviflora	mingi-mingi like shrub
Cyathodes robusta	" " " "
Dicksonia fibrosa	tree fern
Dicksonia squarrosa	" "
Disphyma australe	ice plant
Dracophyllum arboreum	tarahinau
Dracophyllum paludosum	shrub dracophyllum
Festuca littoralis	shore fescue
Hebe barkeri	tree hebe
Hymenanthera chathamica	small forest tree
Leptocarpus similis	jointed rush
Macropiper excelsum	pepper tree
Myrsine chathamica	tree myrsine
Olearia chathamica	a large flowered tree olearia
Olearia semidentata	a shrub olearia
Olearia traversi	Chatham Island akeake
Phormium tenax	New Zealand flax
Pimelia arenaria	sand pimelia
Plagianthus betulinus	ribbonwood
Pteridium aquilinum var. esculentum	bracken
Rhopalostylis sapida	nikau
Scirpus nodosus	a sand-binding sedge
Senecio huntii	rautini
Sonchus grandifolius	native sowthistle
Sporodanthus traversii	a tall reed
Tetragonia spp	native spinach
Urtica australis	bush nettle

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ig.1 Chatham Islands, showing places mentioned in the text, and the sites of the forest quadrats 1 to 20