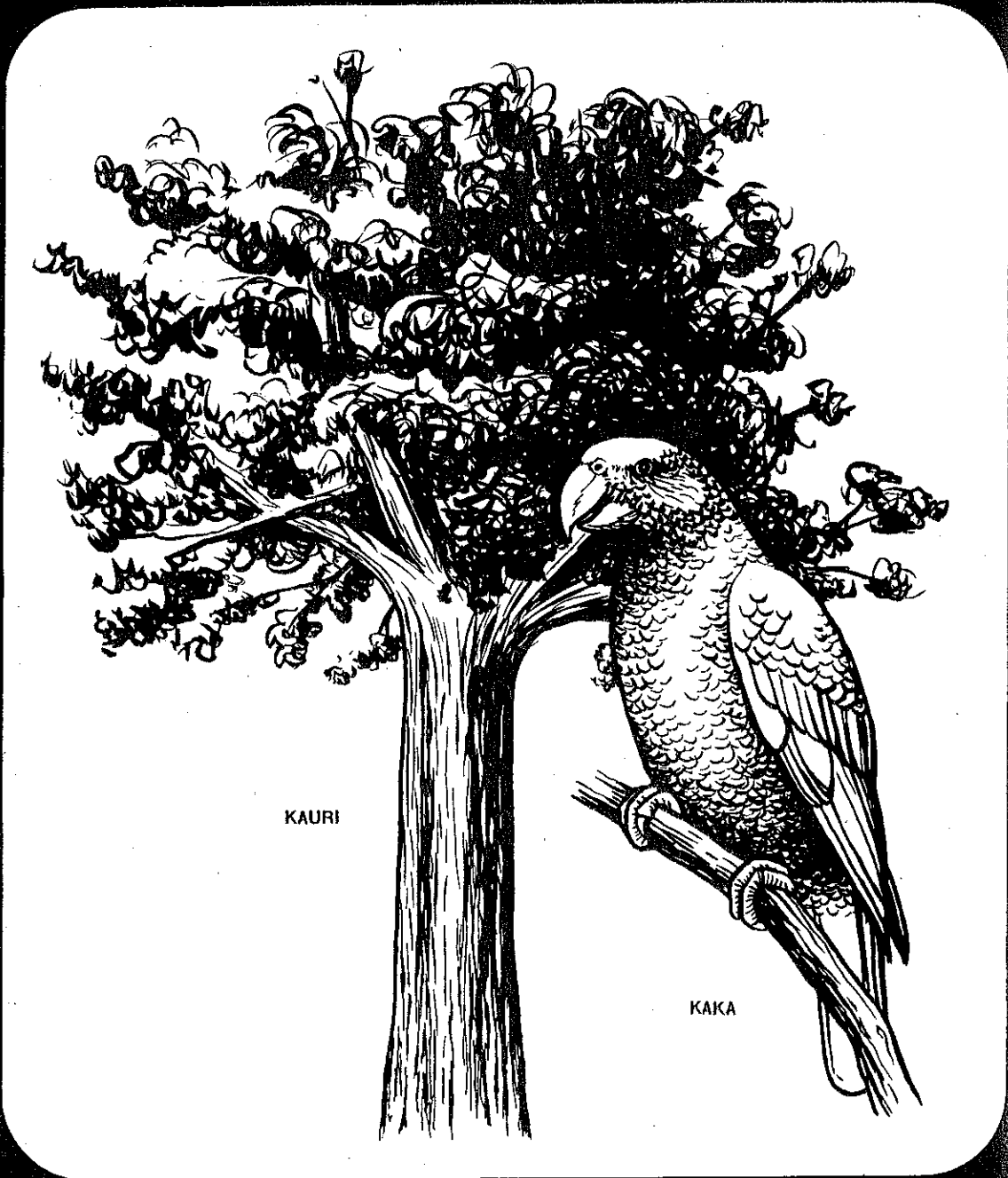


Manaia Forest Sanctuary



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Auckland Conservancy
DEDICATED AREAS REPORT

No.5

MANAIA FOREST SANCTUARY



NZ FOREST SERVICE
AUCKLAND CONSERVANCY
CPO Box 39
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(This is an unpublished internal report)

Bruce Burns
August 1984

MANAIA FOREST SANCTUARY

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Location (Figure 1)

The Manaia Forest Sanctuary lies in an isolated catchment 27 km north of Thames. It consists of a central region containing a stand of large kauri surrounded by further indigenous forest and forms part of the Waikawau Block of the Coromandel State Forest Park. The reserve covers 481 ha; its midpoint at map ref. NZMS 1 N44 040560. The northeastern boundary and the northwestern corner adjoin blocks of privately owned land currently undeveloped. Manaia Forest Sanctuary also exists within the Thames Ecological District though close to its boundary (Simpson 1982, BRC 1983). The most recent aerial photographs were flown on the 25th January 1984. They are photos 5, 6; Run L; survey no. 8163 (NZAM 1984, scale = 1:25,000).

Access

To visit a Sanctuary, members of the public require a permit from the NZFS. Visits for bonafide reasons only are allowed. Two main routes lead to the edge of the Sanctuary. With approval from the landowner, Mr Alec Lumsden, one can travel to the main Manaia-Waikawau ridge by following the Waikawau River via farm roads reaching the Puketotara trig point. From there derelict logging roads penetrate to the Horomanga-Puketotara ridge overlooking, and a further extension leads down into, the Sanctuary. These roads are not negotiable by 4-wheeled vehicles due to slips.

Access may also be gained from the summit of the 309 road between Coromandel and Kaimarama again through private land (ask permission from landowner Mr Raghu Vansh Giri). Another old logging road leads into the Sanctuary from this side.

In the recent recreational strategy suggested for the Coromandel State Forest Park (Holder et al 1983), a potential track is marked from the 309 road, crossing the summit of Kakatarahae then continuing south eventually joining with the existing track to the summit of Papakai. This track may in future provide an easier route to the edge of the Sanctuary and also give access to the high altitude vegetation around the Kakatarahae summit.

History of Gazettal

Logging of indigenous timbers was carried out by the Thames Sawmilling Company in the Waikawau Block throughout the 1960's. In 1969 the Company was completing extraction from catchments to the south of the upper Kakatarahae Stream catchment and sought permission to extend their operations northward. The Company built logging roads to the Horomanga ridge and initial reconnaissance of the area was undertaken by NZFS personnel.

Opposition to the proposed logging of the Kakatarahae catchment was expressed publicly and privately to the Minister of Forests by many individuals and societies including Prof. F.J. Newhook (University of Auckland), the Coromandel Physical Environment Society, the Royal Forest and Bird Protection Society and the Coromandel County Council.

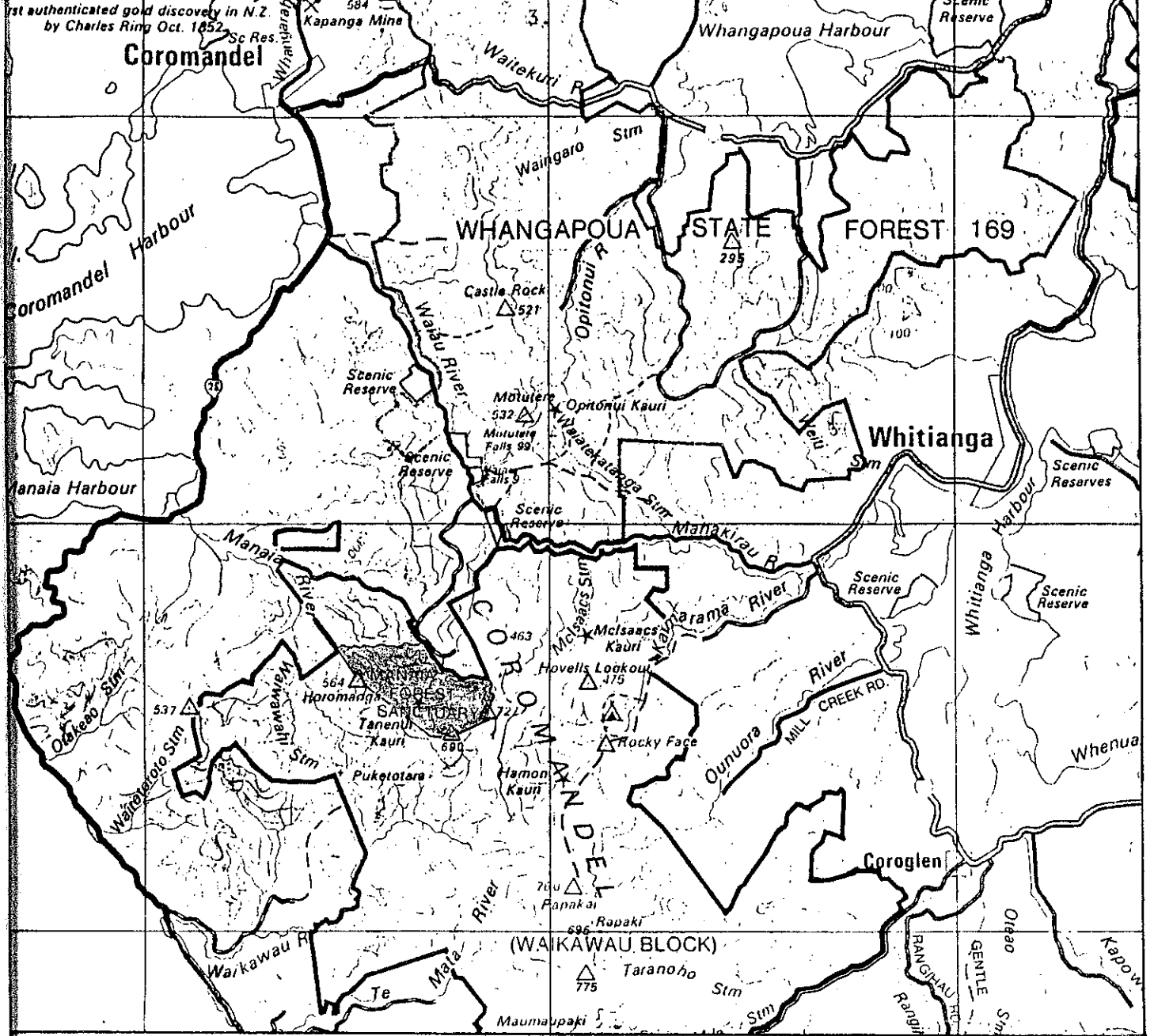




Fig 1 : Location Diagram : Manaia Forest Sanctuary

(based on NZMS 274 Coromandel State Forest Park, 1st Edition 1979, NZFS, Government Printer)

Forest Sanctuary 

State Forest Park Boundary 

Scale 1:150,000



Because of this interest, detailed appraisals of the timber resource present were conducted by the NZFS (Johnston 1970a).

The issue became contentious enough for the then Minister of Forests, the Hon. Mr D. McIntyre, to personally inspect the area. After this inspection, the Minister decided that the area would become a forest sanctuary. Final gazettal occurred on the 24th of August 1972 (Gazette reference No. 70, p. 1817, August 1972).

Rationale and Objectives of Designation

Forest sanctuaries are gazetted for the purpose of 'preserving in their natural state the indigenous flora and fauna therein and for scientific and other like purposes' (Section 20, Forests Act 1949). They are the most legally secure type of reserve of forest land as they can only be revoked by Act of Parliament.

As indicated previously, access is restricted (Auckland Conservancy file 6/0/21, Head Office memo, 21st August 1975).

The qualities desirable in a reserve have been listed by the Scientific Co-ordinating Committee (1980) (now the State Forest Scientific Reserves Advisory Committee). The Manaia Forest Sanctuary has many of the qualities described. In particular it is compact and covers one complete undisturbed catchment of a permanent waterway. Its boundaries are clearly defined by natural features and it is unroaded.

According to the management plan for the Coromandel State Forest Park (NZFS 1978), the purpose of the Manaia Forest Sanctuary is:

'to reserve the only remaining concentrated stands of mature mid-altitude kauri on the Coromandel Range and the surrounding softwood-hardwood forest in the upper Kakatarahae Catchment and the high altitude ridge top softwood-hardwood type ...'

The reserve has been given an IUCN* classification of I (Strict Nature Reserve). IUCN management objectives of this type of reserve are:

'to protect nature and maintain natural processes in an undisturbed state in order to have ecologically representative examples of the natural environment available for scientific study, environmental monitoring, education and for the maintenance of genetic resources in a dynamic and evolutionary state'.

(IUCN 1978)

Climate

The closest weather recording station to the Manaia Forest Sanctuary is at Coromandel township. This station has not been operating for long and few records are available. In 1981, the station recorded total rainfall of 2042 mm with a mean daily maximum of 19.6°C and a mean daily minimum of 11.0°C (NZMS 1981).

*IUCN = International Union for the Conservation of Nature and Natural Resources.

However, the recording station is near sea level and the climate actually experienced in the Sanctuary will be subject to the effects of altitude and conditions of local exposure. Further discussions of climate on the Coromandel Peninsula are given in Burns (1983) and Maunder (1974).

Topography

The Manaia Forest Sanctuary is defined by ridges enclosing the upper part of the Kakatarahae catchment. The area is comprised of steep (greater than 35°) long mountain slopes rounding off to moderately steep ridge tops (slopes of 21-25°) (Water and Soil Division, MOWD, 1975). The reserve has an altitudinal range between 210 m and 730 m. A 46 m waterfall occurs on the Kakatarahae Stream (Sale 1978 p. 213) just outside the Sanctuary boundary.

Geology

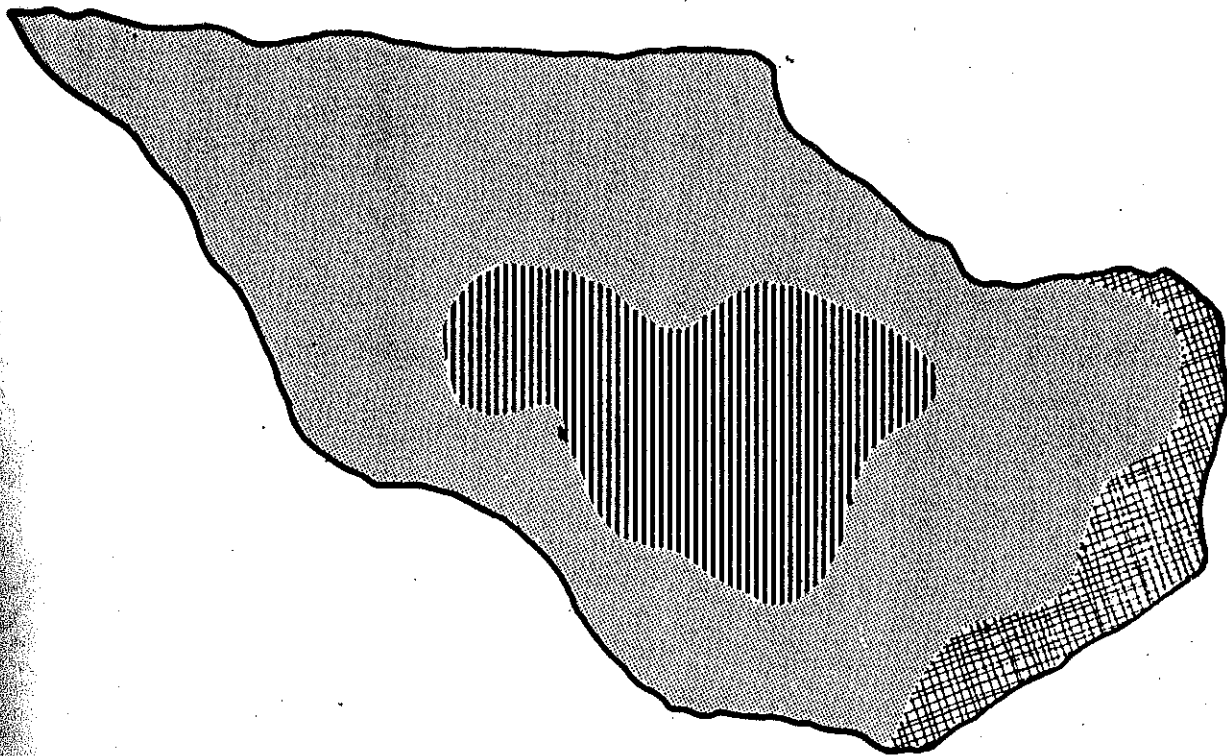
Most of the Manaia Sanctuary occurs on Beesons Island Volcancics, andesitic rocks probably deposited subaerially through the Miocene. This volcanic activity ceased in or before the Pliocene (DSIR 1967). However in the lowest reaches of the Kakatarahae Stream the underlying conglomerates, siltstones and sandstones have been exposed (Cornwell 1967). These are mostly Mesozoic rocks of the Manaia Hill formation. Mineralisation and alteration due to hydrothermal activity is widespread in these rocks with the greatest concentrations of minerals occurring outside the Sanctuary. Stevens (1980) has investigated quartzdiorite porphyry stock in the lower Kakatarahae Stream associated with extensive hydrothermal alteration and mineralisation. Slane and White (1980) record two old gold mines in the Manaia River to the south of the Sanctuary (refer: Human History and Influence).

Pedology and Erosion

The Manaia Forest Sanctuary contains Aroha and Te Kie steepland soils. Aroha steepland soils are sandy or clay loam skeletal soils of medium to low natural fertility derived from andesitic rock. Te Kie steepland soils are stony clay loams from analite basalt and andesite of medium to high natural fertility. Only slight debris avalanche and soil slip types of erosion were observed. The land within the Sanctuary is classified as class VII (Water and Soil Division, MOWD, 1975).

Vegetation

This description is derived from four days field work (13th, 14th April 1983 and 14th, 15th March 1984) and from surveys conducted in 1949 and 1966 (NZFS 1949, 1966). Overlay 2 of figure 2 shows the locations of the various field descriptions made.



Overlay 1 : Forest Types



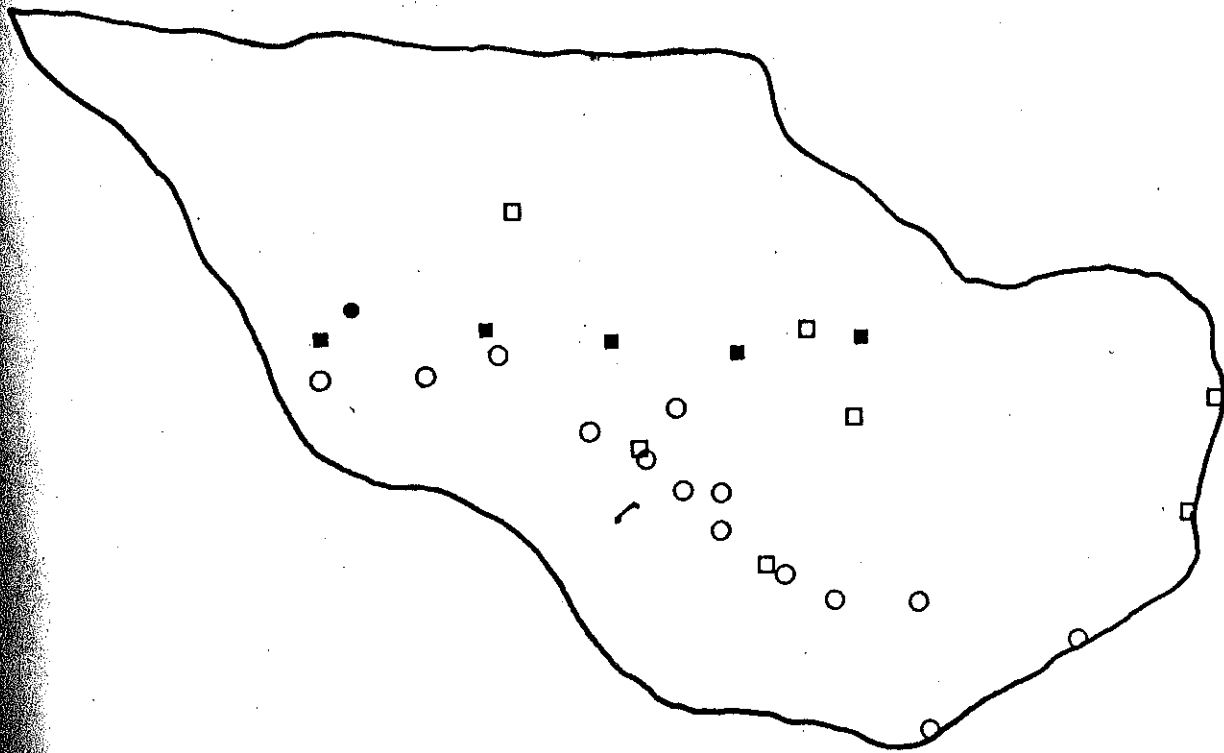
mid altitude kauri-podocarp hardwood



mid altitude podocarp-hardwood



high altitude podocarp-hardwood with rare
kauri and kaikawaka



Overlay 2 : Location of Vegetation Descriptions

- NZFS 1949
- NZFS 1966
- Burns 1983-84
- unconfirmed report of *Blechnum vulcanicum*
(NZFS 1949)
- { kauri dam remains

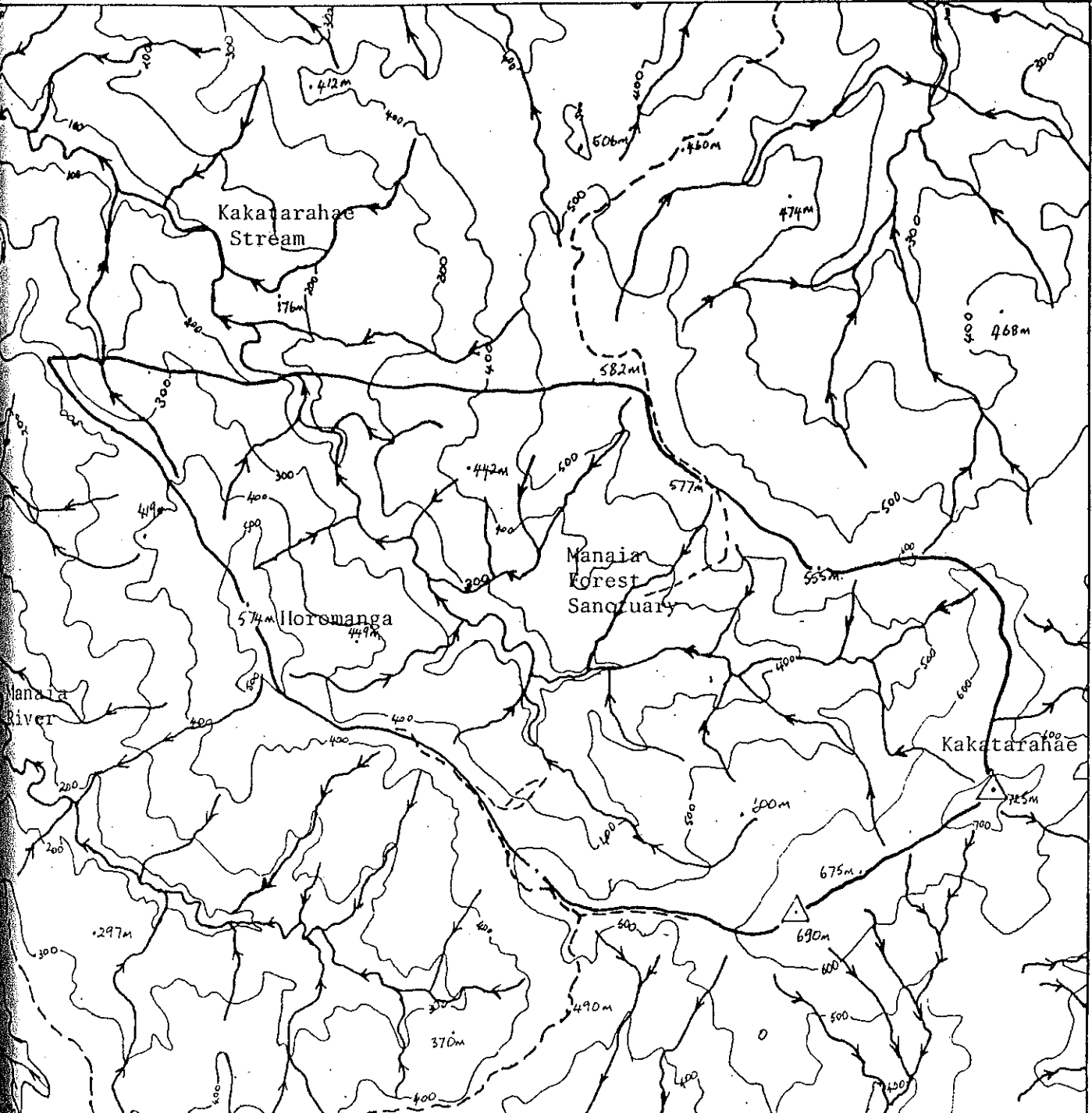
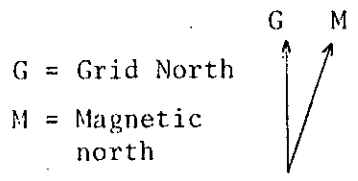


Figure 2 : Manaia Forest Sanctuary

- 100 — 100 m interval contours
- Forest Sanctuary boundary
- - - old logging roads
- stream
- △ trig station

Scale:
1:25,000



The method used for the 1983-84 fieldwork was a modified recce-type system recording species present in a number of tiers. The five tiers used are: canopy emergents; canopy; subcanopy (from beneath canopy height down to 2 m); shrub (2 m down to 50 cm) and groundcover (50 cm to ground level). Epiphytes and climbers are also recorded. Site descriptions are grouped into types based as closely as possible on those classified by Nicholls (1976). Further discussions of this procedure is given in Burns (1983).

I have divided the forest into three general types:

1. mid-altitude kauri-podocarp-hardwood forest (Type B5, Nicholls 1976);
2. mid-altitude podocarp-hardwood forest (Type D8, Nicholls 1976; and
3. high-altitude podocarp-hardwood forest (with rare kauri and kaikawaka) (closest to type G7, Nicholls 1976).

The extent of these types is shown on overlay 1 of figure 2. A botanical species list is given as appendix 1, giving both scientific and common names for plants present.

The first type, mid altitude kauri-podocarp-hardwood (Table 1 gives a generalised stand structure), occurs in the centre of the catchment extending up to approximately 500 m altitude. This stand of impressively large kauri is the main reason for the existence of the Sanctuary. A detailed estimate of the timber volume in kauri over 30 cm dbh was carried out by Johnston (1970a). Four hundred and ten kauri stems were counted and measured averaging 20.4 m³ with a total volume of 8364 m³ timber. Many of the large kauri show senescent crowns and have been bled for gum. The condition of these trees will be discussed in the next section (Introduced Animals and Forest Condition).

The type is characterised by emergent kauri with occasionally emergent rimu, Hall's totara and northern rata. The kauri are not particularly dense and the composition of the rest of the type is very similar to the surrounding podocarp-hardwood type except for the groundcover. Here *Astelia trinervia*, *Gahnia pauciflora* and *Blechnum fraseri* are common to the kauri type alone.

Nicholls (1972) compared the Kakatarahae and Waiomu kauri stands with a general type. He found the Kakatarahae stands rather more heavily stocked than most of the remaining virgin kauri forest below 1500 ft on the Coromandel Range but noted the high incidence of decadent trees and a lack of regeneration. He also commented that the absence of tanekaha (*Phyllocladus trichomanoides*) and the relative prominence of tawheowheo may be due to the stands in the Kakatarahae catchment occurring toward the upper limit of the general kauri type.

The impression of a senescent kauri population with no regeneration may be misleading. In several small areas within the kauri type are stands of dense towai with kauri seedlings beneath them.



Photo 1: Manaia Forest Sanctuary looking north (photo by B. Burns)



Photo 2: Remains of small kauri dam within the Sanctuary (photo by B. Burns)

TABLE I : GENERALISED STAND STRUCTURE FOR
MID-ALTITUDE KAURI-PODOCARP-HARDWOOD FOREST

TIER	← INCREASING DOMINANCE →			
	ABUNDANT	FREQUENT	OCCASIONAL	RARE
EMERGENT		kauri	northern rata rimu Hall's totara	
CANOPY		towai tawari tawa	tawheowheo kauri miro Hall's totara	
SUBCANOPY		tawari towai	<i>Cyathea smithii</i> heketara pigeonwood hinau fivefinger	
SHRUB			mingimangi Hall's totara kauri wheki neinei karamu mamangi	
GROUNDCOVER		<i>Gahnia pauciflora</i> <i>Blechnum fraseri</i> <i>Astelia trinervia</i>	<i>Hymenophyllum</i> spp kiekie kidney fern Hall's totara seedlings tawa seedlings	<i>Gleichenia cunninghamii</i> <i>Lycopodium</i> spp
EPIPHYTES AND CLIMBERS		supplejack mangemange kiekie <i>Collospermum hastatum</i>	<i>Metrosideros</i> spp kidney fern <i>Dendrobium cunninghamii</i>	

DISTRIBUTION: 300-500 m asl in centre of upper Kakatarahae Stream catchment.

NOTES: A variety of species make up the shrub layer with many seedlings. This kauri type (B5, Nicholls 1976) differs from others in the Coromandel by the absence of tanekaha.

Also within these stands cut stumps of kauri were found. One was measured at 130 cm dbh. Cornwell (1949) noted towai as a nurse crop for the Manaia area. He also reported that early logging removed the smaller diameter trees from the area thus the original population was not as senescent as it now appears. This fact is confirmed by Sale (1978 p. 166). He states that smaller kauri up to 3 m in girth, were cut out by the Kauri Timber Company in about 1880.

The second type recognised is a mid-altitude podocarp-hardwood forest type (generalised stand structure; Table II). This type has occasionally emergent rimu, miro, Hall's totara and northern rata over a canopy of tawa, towai and tawari. Pukatea occurs on wet gully sites with pate, *Fuchsia excorticata* and wineberry. The type is characterised by a mixture of hardwood species and tree ferns in the subcanopy and shrub tiers. Kiekie and supplejack are dense over most of this type, kiekie especially so in the shrub tier, making travel difficult. Bush rice grass and hook grass form a groundcover where kiekie isn't present. The type extends up to 600 m altitude.

Above 600 m, around the summit of Kakatarahae, is an area supporting a highly variable high altitude vegetation (generalised stand structure; Table III). Canopy height varies from 2 m with occasional emergent trees to an even 10 m. Areas with the shortest canopy may be regenerating from some disaster, eg fire, windthrow. Many species of higher altitudes in the Coromandel are present eg *Griselinia littoralis*, southern rata, *Pseudopanax colensoi*, *P. anomalum*, tawheowheo, *Coprosma colensoi (banksii)*, *Dracophyllum pyramidale*. These species find their northern limits on the Coromandel Range (Braggins et al 1983). There are a few emergent kauri and the occasional large kaikawaka. Immediately around the Kakatarahae trig is a dense stand of young kaikawaka up to 2 m tall with many seedlings also present. The dynamic vegetation processes apparent on this high ridge parallel those occurring on the Papakai plateau. Papakai has recently been gazetted an Ecological Area because of the intrinsic ecological value of the plateau region. The summit of Kakatarahae, by virtue of its similarities, must have similar values.

This high altitude area is often covered in cloud and rain, and in places the groundcover is of rushes indicating long periods of soil saturation.

The sixth largest kauri known and the largest on the Coromandel Peninsula stands in the Manaia Sanctuary (NZFS 1983a). This tree, Tanenui (map ref. NZMS1 N44 042558), has a girth of 10.08 m and an estimated trunk volume of 135.7 m³.

Plants present in the Sanctuary but rare elsewhere on the Coromandel Range are kaikawaka and *Metrosideros albiflora* (NZFS 1978, Appendix 13). There is also an unconfirmed report of *Blechnum vulcanicum* on the slopes of Horomanga within the Sanctuary (NZFS 1949).

TABLE II : GENERALISED STAND STRUCTURE FOR
MID-ALTITUDE PODOCARP-HARDWOOD FOREST

TIER	← INCREASING DOMINANCE →			
	ABUNDANT	FREQUENT	OCCASIONAL	RARE
EMERGENT			rimu miro northern rata Hall's totara	*pukatea
CANOPY		tawa tawari towai	hinau mamaku rewarewa fivefinger heketara miro	
SUBCANOPY	kiekie	pigeonwood kohekohe mamaku <i>Cyathea smithii</i> mamangi nikau	lancewood tawheowheo mahoe	*pate * <i>Fuchsia</i> <i>excorticata</i>
SHRUB		<i>Cyathea smithii</i> kohekohe mamangi wheki	<i>Cyathea dealbata</i> heketara	
GROUNDCOVER		bush rice grass hook grass kiekie	hen & chicken fern <i>Lastreopsis</i> <i>hispida</i> <i>Blechnum</i> spp	
EPIPHYTES AND CLIMBERS		supplejack kiekie mangemange	kidney fern <i>Metrosideros</i> spp	

DISTRIBUTION: from 210 m - 600 m covering most of Sanctuary except central kauri area and high altitude vegetation.

NOTES: * found in wet gully situations.

(Type D8, Nicholls 1976)

TABLE III : GENERALISED STAND STRUCTURE FOR
HIGH ALTITUDE PODOCARP-HARDWOOD
FOREST (WITH RARE KAURI AND KAIKAWAKA)

TIER	← INCREASING DOMINANCE →			
	ABUNDANT	FREQUENT	OCCASIONAL	RARE
EMERGENT				kauri rimu
CANOPY		towai tawari tawheowheo toro	kaikawaka	
SUBCANOPY))))))	towai tawheowheo wheki <i>Cyathea</i> <i>smithii</i> heketara	karamu mamangi <i>Pseudopanax</i> <i>colensoi</i> <i>Hebe stricta</i> toro	<i>Senecio kirki</i> <i>Dracophyllum</i> <i>pyramidale</i> kaikawaka <i>Pseudowintera</i> <i>axillaris</i>
SHRUB))))))	broadleaf		southern rata putaputaweta swamp maire
GROUNDCOVER		bush rice grass kauri grass mosses	*kiokio *hard fern * <i>Juncus</i> spp *bush lawyer hookgrass	
EPIPHYTES AND CLIMBERS			supplejack <i>Hymenophyllum</i> <i>multifidum</i> moss kiekie	

DISTRIBUTION: Above 600 m altitude around Kakatarahae summit.

NOTES: Closest to Type G7, Nicholls (1976). A dense sward of young kaikawaka occurs close to the Kakatarahae trig.

* In wetter areas usually with low canopy.

Introduced Animals and Forest Condition

Goats and wild pigs have been present in the Manaia Sanctuary for many years. Cornwell (1949) noted their presence and stated that:

'the undergrowth has been opened up considerably in some places'.

Nicholls (1972) reported that:

'the undergrowth of the Kakatarahae Valley has been much depleted by the browsing of goats and their tracking and trampling of the forest floor'.

Introduced mammals have probably affected the composition of at least the understory. However, my observation of the Sanctuary was of dense undergrowth, particularly kiekie, and little goat or pig sign. Of 48 4 m² circular plots examined only 4 (8.3%) contained intact goat pellets. Pig rooting was also found. Surprisingly I did not find any possum droppings in the catchment although I noted some possible possum browse. Animal browse was recorded on *Dianella nigra*, *Astelia trinervia*, *Blechnum fraseri*, kiekie and *Dicksonia squarrosa* though nowhere was it more than light.

Goats do occur in abundance in the vicinity of the Sanctuary. Whilst tramping along farmland boundaries and old logging roads, 53 goats were seen in two hours with one herd of approximately thirty animals. Cattle droppings were also present on the logging roads.

Forest condition can be assessed by considering:

1. The presence of seedlings and saplings of canopy species (evidence for regeneration or change in the forest cover);
2. The openness of the vegetation as a whole and in the different tiers; and
3. The presence of dead or dying individuals.

It must always be realised, however, that this is a static examination of time-dependent processes. In the Manaia Sanctuary there are many seedlings and saplings of canopy tree species including areas of young kauri and a dense sward of young kaikawaka on the summit of Kakatarahae. The undergrowth is dense with no recognisable 'browse zone'. Most canopy trees are healthy except for a number of the large kauri, 68% of which have been bled for gum (Johnston 1970b). Gumbleeders have left large scarps in the trunks of these trees allowing access for timber rotting fungi.

To assess the overall health of the kauri, Johnston (1970b) classified the crowns of the large (>30 cm dbh) kauri according to their condition as follows.

TABLE IV : DISTRIBUTION OF CROWN HEALTH OF LARGE KAURI

CROWN CLASSIFICATION	NO. OF TREES	% OF TREES
D.D. = dead down trees	21	5.1%
C.0. = dead standing tree - no foliage	13	3.2%
C.1. = one branch still alive	12	2.9%
C.2. = several branches containing light foliage	17	4.1%
C.3. = green crown beginning to dominate over dead portions	116	28.3%
C.4. = green crown dominant - some dead branch ends and dry spikes evident	212	51.7%
C.5. = completely defect free top	19	4.6%
Totals	410	100%

Two taraire seedlings were found in the Sanctuary. This species is a dominant of northern coastal forest but is only present in small coastal bush remnants on the northern part of the Coromandel Peninsula. These seedlings are probably the result of seed transfer by native pigeons from coastal areas and although their continued existence and growth in this forest is unlikely, they indicate the range of habitats utilised by native birds; from the coast to the heights.

Presence of Exotic Plants

There are few exotic plant species present in the actual Sanctuary and none pose any threat to the native vegetation cover. Occasional adventive weeds are present on several small slip areas. However, the logging roads which penetrate to the edge of the Sanctuary have several exotic species growing on them; eg gorse (*Ulex europaeus*) and pampas grass (*Cortaderia selloana*). These highly competitive species could invade the Sanctuary if suitable habitat (ie major open areas like slips) would occur close to their present range.

Native Fauna

The Wildlife Service has rated the Waikawau Block of the Coromandel State Forest Park, which includes the Manaia Sanctuary, as an 'outstanding' wildlife habitat (Anderson 1983). Wildlife recorded in the Sanctuary by both Wildlife Officers and NZFS personnel are listed in Appendix 2.

The Manaia Sanctuary is notable for its abundant birdlife.

Kaka, N.I. brown kiwi and long-tailed cuckoo are present. The first two species have a limited distribution in New Zealand whilst the third is migratory and only found in low numbers in the Coromandel.

The two native frogs found are listed as endangered in the Red Data Book of New Zealand (Williams and Given, 1981). Archey's frog is only found on the Coromandel and Hochstetter's frog has only a limited distribution elsewhere in the country.

Human History and Influence

There are no recorded archaeological sites for former Maori occupation or use of the Manaia Sanctuary. However sites have been recorded from further down the Manaia River Valley (N.Z. Historic Places Trust personal communication to Conservancy Archaeologist).

More recent history is concerned with timber extraction, gum-bleeding and to a lesser extent, prospecting and mining for gold.

Sale (1978) notes:

'the Sanctuary area ... was worked well back in the kauri logging days, but not extensively. Samuel Strongman built three dams there in the late 1890s for the Kauri Timber Company, but the contract was abandoned after the first drive in which most of the logs sent down were smashed at the bottom of a 46 m waterfall below the main dam.'

Remains of a small dam (probably not the main dam) were found at map ref. NZMS1 N44 037555. Johnston (1970a) also found dam remains and stumps of medium sized trees. Cornwell (1949) and Sale (1978) both note that only the smaller diameter trees were removed during milling of the main Manaia forest. No explanation for this unusual selection is given.

In 1970, nineteen kauri were taken from the vicinity by a local logging company just before the Manaia area was made a Sanctuary (Sale 1978). Logging roads lead down into the reserve from both sides.

Many of the large kauri in the Sanctuary have been bled for gum with large scarps cut into their trunks. Some have been almost ringbarked. Newhook (1970) estimated that the gum bleeding took place circa 1890.

Fire probably occurred around the summit of Kakatarahae and in small areas around the creek beds. (Cornwell 1949)

Quartz is present in the streambed of the lowest part of the Sanctuary. Here too, a small adit was found (map ref. NZMS1 N44 038558) indicating that some mining or prospecting has occurred. Further to the west



Photo 3: Tanenui within Manaia Forest Sanctuary, the sixth largest kauri (photo by B. Burns)

and in the Manaia Stream catchment to the south, areas of concentrated mineral deposits have been discovered (Stevens 1980). Slane and White (1980) describe two working claims from the latter catchment, just outside the Sanctuary. The first, the Golden Hills Claim, was discovered in 1885 and produced 1.4 kg of bullion; the second, the Jubilee Claim, worked between 1887 and 1888 for 7.0 kg of bullion.

Recreational Facilities and Opportunities

The Manaia Sanctuary is isolated, untracked and has no huts or other recreational facilities. There is potential for a track to cross the Kakatarahae summit (Holder et al 1983). Opportunities for trampers are limited by the isolation and rugged terrain of the catchment. The same factors restrict pig and goat hunting in the Sanctuary. Access is restricted anyway by the need for a permit to visit the Sanctuary.

Research Carried Out and Suggested

Ahmed Moinuddin of the University of Auckland has recently completed a PhD thesis on the dendrochronology of kauri in New Zealand (Moinuddin 1984). He has used the Manaia Sanctuary as a study area, taking increment cores from some of the kauri and sampling the vegetation using a point-centred quarter (PCQ) method (Cottam and Curtis 1956). Ages were estimated from cores. They range between 441 years for a kauri with an 86.6 cm diameter to 2499 years for a kauri with a 298.8 cm diameter. Moinuddin considers these estimates somewhat unreliable; still they indicate that the true ages for these trees are impressive.

The PCQ description taken over 20 tree species gave a stand density of 621 stems ha^{-1} and a stand basal area of 177 m^2ha^{-1} . Kauri alone had a density of 47 stems ha^{-1} and a basal area of 127.3 m^2ha^{-1} .

The Manaia Forest Sanctuary would be useful for further research into kauri, and for investigation into the unusual vegetation around the Kakatarahae summit, particularly the young stands of kaikawaka. The isolated nature of the catchment and its rich bird life may make it useful for wildlife studies.

Summary, Discussion and Recommendations

The Manaia Forest Sanctuary covers 481 ha in an isolated catchment of the Coromandel Peninsula, 27 km north of Thames. The reserve is composed of steep long mountain slopes rising to the summit of Kakatarahae at 730 m. The underlying rock is andesitic (Beeson's Island Volcanics) overlain with Te Kie and Aroha steepland soils of medium fertility.

I have divided the vegetation into three types: mid-altitude kauri-podocarp-hardwood forest, mid-altitude podocarp-hardwood forest and high altitude podocarp-hardwood forest with rare kauri and kaikawaka. The kauri type contains over 400 large kauri trees.

This stand forms the major reason for the existence of the reserve. The sixth largest kauri known, Tanenui, occurs in the Sanctuary. Many of these trees have been bled for gum and are showing signs of senescence. The high altitude vegetation around the summit of Kakatarahae, particularly the dense young stand of kaikawaka, contains plants rare on the Coromandel and has recognised ecological value.

The wildlife rating of the region including the Manaia Sanctuary is outstanding. Kaka, N.I. brown kiwi and long-tailed cuckoo have been recorded. Goats and pigs occur in the Sanctuary but not in large numbers. Surprisingly possums seem to be rare. Some logging of smaller diameter kauri has occurred in the past. Mining for gold was carried out in the adjacent catchment. To gain access, visitors require an NZFS permit. A bonafide reason for entering the Sanctuary is necessary before a permit will be given.

Manaia's Sanctuary status gives it a legal protection greater than for an Ecological Area, and therefore suggests higher ecological values. However, when this Sanctuary was gazetted, the Ecological Area designation did not exist. I regard Manaia's ecological values similar to those of nearby Ecological Areas, and believe that in most management concerns it should be treated as one. The same applies to a number of the early Sanctuaries (NZFS 1983b).

A remeasurement of the large kauri including a reassessment of their crown condition, as carried out by Johnston (1970), would provide excellent data on their rate of deterioration, particularly due to gumbleeding.

Although there are few goats within the Sanctuary itself the logging roads and farm boundaries nearby support a large goat population. These goats could move into the Sanctuary if they became overcrowded in their preferred habitat or if they are forced to disperse as a result of low intensity hunting or hunting with dogs. Control, if necessary, must be swift and sudden aiming to keep the remaining population on the logging roads. (A. Leigh pers. comm.) Goats may also help to control exotic weeds present reducing the chance that these will invade into the Sanctuary.

The Manaia Sanctuary has one boundary and one corner adjacent to private land. Although this land is currently undeveloped, future clearance and stocking could have major effects on the Sanctuary. The intentions of the landowners should be ascertained and their co-operation gained in maintaining a forested buffer zone around the Sanctuary.

Management recommendations in order of priority are:

1. that NZFS remeasure the large kauri, repeating the 1970 survey;
2. that NZFS keep the goat populations around and within the Sanctuary at a low level;

3. that NZFS set up several permanent plots representing each vegetation type, to monitor vegetation and indicate trends;
and
4. that NZFS seek the co-operation of adjacent landowners in maintaining a forested buffer zone around the Sanctuary.

Acknowledgements

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APPENDIX 1 : BOTANICAL SPECIES LIST - MANAIA FOREST SANCTUARY

FERNS

<i>Asplenium bulbiferum</i> var. <i>bulbiferum</i>	hen and chicken fern
<i>A. flaccidum</i> var. <i>flaccidum</i>	
<i>A. oblongifolium</i>	
<i>A. polyodon</i>	
<i>Blechnum chambersii</i>	
<i>B. colensoi</i>	
<i>B. discolor</i>	crown fern
<i>B. filiforme</i>	
<i>B. fluviatile</i>	
<i>B. fraseri</i>	
<i>B. membranaceum</i>	
<i>B. capense</i>	kiokio
<i>Ctenopteris heterophylla</i>	
<i>Cyathea dealbata</i>	ponga
<i>C. medullaris</i>	mamaku
<i>C. smithii</i>	
<i>Dicksonia squarrosa</i>	wheki
<i>Doodia media</i>	
<i>Gleichenia cunninghamii</i>	umbrella fern
<i>G. dicarpa</i>	swamp umbrella fern
<i>Grammitis billardieri</i>	
<i>G. ciliata</i>	
<i>Histiopteris incisa</i>	histiopteris, water fern
<i>Hymenophyllum demissum</i>	filmy fern
<i>H. dilatatum</i>	filmy fern
<i>H. ferrugineum</i>	filmy fern
<i>H. flabellatum</i>	filmy fern
<i>H. multifidum</i>	filmy fern
<i>H. revolutum</i>	filmy fern
<i>H. sanguinolentum</i>	filmy fern
<i>H. scabrum</i>	filmy fern
<i>Hypolepis distans</i>	
<i>Lastreopsis hispida</i>	
<i>Leptopteris hymenophylloides</i>	
<i>Lindsaea trichomanoides</i>	
<i>Lygodium articulatum</i>	mangemange
<i>Paesia scaberula</i>	hard fern, ring fern
<i>Phymatodes scandens</i>	fragrant fern
<i>Pneumatopteris pennigera</i>	
<i>Pteridium acquilinum</i> var. <i>esculentum</i>	bracken
<i>Rumohra adiantiformis</i>	
<i>Trichomanes elongata</i>	
<i>T. reniforme</i>	kidney fern

FERN ALLIES

<i>Lycopodium billardieri</i>
<i>L. cernuum</i>
<i>L. deuterodensum</i>
<i>L. volubile</i>
<i>Tmesipteris tannensis</i>

GYMNOSPERMS

<i>Agathis australis</i>	kauri
<i>Dacrydium cupressinum</i>	rimu
<i>Libocedrus bidwillii</i>	kaikawaka
<i>Podocarpus hallii</i>	Hall's totara
<i>Prumnopitys ferruginea</i>	miro

DICOT. TREES AND SHRUBS

<i>Alseuosmia macrophylla</i>	karapapa
<i>Aristotelia serrata</i>	wineberry
<i>Beilschmiedia tarairi</i> (seedlings only)	taraire
<i>B. tawa</i>	tawa
<i>Brachyglottis repanda</i>	rangiora
<i>Carpodetus serratus</i>	putaputaweta
<i>Coprosma grandifolia</i>	mamangi
<i>C. colensoi</i> (<i>banksii</i>)	
<i>C. lucida</i>	karamu
<i>Cyathodes fasciculata</i>	mingimingi
<i>Dracophyllum latifolium</i>	neinei
<i>D. pyramidale</i>	
<i>Elaeocarpus dentatus</i>	hinau
<i>Fuchsia excorticata</i>	kotukutuku
<i>Geniostoma rupestre</i> var. <i>crassum</i>	hangehange
<i>Griselinia littoralis</i>	broadleaf
<i>G. lucida</i>	puka
<i>Hebe macrocarpa</i> var. <i>latisepala</i>	
<i>H. stricta</i>	koromiko
<i>Hedycarya arborea</i>	pigeonwood
<i>Ixerba brexioides</i>	tawari
<i>Knightia excelsa</i>	rewarewa
<i>Laurelia novae-zelandiae</i>	pukatea
<i>Leptospermum ericoides</i>	kanuka
<i>L. scoparium</i>	manuka
<i>Litsea calicaris</i>	mangaeo
<i>Melicytis ramifloris</i>	mahoe
<i>Metrosideros robusta</i>	northern rata
<i>M. umbellata</i>	southern rata
<i>Myrsine salicina</i>	toro
<i>Nestegis lanceolata</i>	white maire
<i>Olearia rani</i>	heketara
<i>Pittosporum cornifolium</i>	
<i>P. kirkii</i>	
<i>Pseudopanax anomalum</i>	
<i>P. arboreum</i>	five-finger
<i>P. colensoi</i>	
<i>P. crassifolium</i>	lancewood
<i>P. edgerleyi</i>	
<i>Pseudowintera axillaris</i>	horopito
<i>Quintinia serrata</i>	tawheowheo
<i>Schefflera digitata</i>	pate
<i>Senecio kirkii</i> var. <i>angustior</i>	Kirk's daisy
<i>Syzygium maire</i>	swamp maire
<i>Toronia toru</i>	toru
<i>Weinmannia silvicola</i>	towai

DICOT. LIANES

<i>Clematis paniculata</i>	puawhananga
<i>Metrosideros albiflora</i>	climbing rata
<i>M. diffusa</i>	climbing rata
<i>M. fulgens</i>	climbing rata
<i>M. perforata</i>	climbing rata
<i>Rubus australis</i>	bush lawyer
<i>R. cissoides</i>	bush lawyer

DICOT. HERBS

Acaena anserinifolia
Epilobium nerteriodes
E. rotundifolium
Gnaphalium gymnocephalum
G. keriense
Hydrocotyle dissecta
Lagynifera pumila
Lobelia anceps
Nertera depressa
N. dichondraefolia
Senecio minimus
Viola filicaulis

GRASSES

<i>Cortaderia fulvida</i>	
<i>Ehrharta diplax</i>	bush rice grass
<i>Miscanthus nepalensis</i>	

ORCHIDS

Bulbophyllum pygmaeum
Corybas orbicularis
C. rivularis
Dendrobium cunninghamii
Earina autumnalis
E. mucronata
Pterostylis graminea

OTHER MONOCOTS

<i>Astelia fragrans</i>	
<i>A. ?grandis</i>	
<i>A. solandri</i>	
<i>A. trinervia</i>	kauri grass
<i>Carex dissita</i>	
<i>C. geminata</i>	
<i>Collosperrum hastatum</i>	
<i>Cordyline banksii</i>	

<i>Dianella nigra</i>	blue-berry
<i>Elaeocharis gracilis</i>	
<i>Freycinetia baueriana</i> subsp. <i>banksii</i>	kiekie
<i>Gahnia pauciflora</i>	
<i>G. setifolia</i>	
<i>Juncus planifolius</i>	
<i>Libertia pulchella</i>	
<i>Schoenus masculinus</i>	
<i>Rhopalostylis sapida</i>	nikau
<i>Ripogonum scandens</i>	supplejack
<i>Uncinia uncinata</i>	hookgrass
<i>U. zotovii</i>	

APPENDIX 2 : WILDLIFE OF THE MANAIA FOREST SANCTUARY

* Recorded by Anderson (1983)

□ Recorded by author and A. Warren during field work 1984

NATIVE BIRDS

□ * <i>Anthornis melanura</i>	bellbird
□ <i>Apteryx australis</i>	N.I. brown kiwi
* <i>Chalcites lucidus</i>	shining cuckoo
□ <i>Eudynamis taitensis</i>	long-tailed cuckoo
□ * <i>Gerygone igata</i>	grey warbler
* <i>Halcyon sancta</i>	kingfisher
□ * <i>Hemiphaga novaeseelandiae</i>	N.Z. pigeon
□ * <i>Nestor meridionalis</i>	kaka
□ <i>Ninox novaeseelandiae</i>	morepork
* <i>Petroica macrocephala</i>	pied tit
□ * <i>Prothemadera novaeseelandiae</i>	tui
□ * <i>Rhipidura fuliginosa</i>	fantail
* <i>Zosterops lateralis</i>	silveryeye

INTRODUCED BIRDS

* <i>Fringilla coelebs</i>	chaffinch
□ <i>Prunella modularis</i>	dunnock
□ * <i>Turdus merula</i>	blackbird

INTRODUCED MAMMALS

□ * <i>Capra hircus</i>	feral goats
* <i>Sus scrofa</i>	wild pigs

NATIVE AMPHIBIANS

* <i>Leiopelma archeyi</i>	Archey's frog
* <i>L. hochstetteri</i>	Hochstetter's frog

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