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KAHIKATEA

Podocarpus dacrydioides

A dissertation
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of the requirements for the
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The opinions expressed within this paper are those of the author and do not necessarily represent those of the New Zealand Forest Service.
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ABSTRACT

Kahikatea (Podocarpus dacrydioides) forests were once found extensively on alluvial plains and river flats throughout New Zealand. Today these forests have dwindled in extent; largely as a result of clearing of the fertile soils for pastoral farming and the use of the non-tainting timber for butter boxes.

Kahikatea is still being used for many purposes despite the availability of suitable substitutes.

The largest remaining areas of kahikatea are in South Westland, where they are protected by a Government-imposed moratorium on logging which expires in 1990. To protect these forests after that date and to establish ongoing reserves, two clear courses of action must be taken: the protection of these forests from logging, and the drawing up and implementing of a policy directed specifically at managing kahikatea in all stages and conditions of its development.
1.0 Introduction

Attention in this paper has been focused on kahikatea throughout New Zealand; the information being obtained from literature that is publicly available. As a background to the subject of kahikatea, it has been necessary to look at a number of pertinent questions to give an explanation of the present status of the species. The questions were:

What was the resource, its ecology and distribution?

What were the past uses? What are the present uses and alternative timbers available?

What are the environmental implications of milling kahikatea?

What legislation may be invoked to conserve or preserve areas of kahikatea?

Which government agencies are responsible for the use of the resource as dictated by existing policy directives?

What are the alternatives and implications for future use and management of kahikatea?

Prior to the arrival of the Maori in New Zealand some 80 percent of the country was covered in forest. Today approximately only 23 percent or less remains (Environmental Council, 1979).

The Maoris intentionally burned areas of indigenous forest to provide for cultivation, but the arrival of Europeans in New Zealand in the last 150 years has had the greatest impact, devastating the forests through deliberate land clearance and sawmilling.

The forests most greatly affected have been the lowland conifer and conifer/hardwood forests, particularly in the North Island. While the total area of indigenous forest has been reduced by 67 percent since European settlement, non
production forest has been reduced by over 80 percent (Environmental Council, 1979). A result of this land clearance has been the substantial loss of certain forest types, such as kauri and kahikatea. As Kirkland and Trotman (1974) observe:

"On swampland, dense kahikatea forest was once common throughout New Zealand, but has now largely given way for farmland."

This devastation of our lowland forests is also stressed by Morton (1981), who laments:

"Most of it we will never see again...lowland kahikatea forests now scarcer than kauri. Some bits remain, often in small choice pockets, precious fragments it will be mean and improvident to destroy."

In a survey of "The Indigenous Forests of New Zealand", Kirkland and Trotman (1974) identified the total area remaining of indigenous forest as approximately 6.25 million hectares (New Zealand Official Yearbook, 1982) or less than one quarter of the total land area of New Zealand, which is 26.9 million hectares.

Salmon (1980) has stated that only 9850 hectares of dense kahikatea swamp forest remains.

At present management of these remnants is under consideration by the New Zealand Forest Service in the South Westland Forest Management Proposals (1980) and the North Westland Regional Management Plan (Draft, 1980). However, as yet there is no policy that specifically recognises the threatened status of dense kahikatea swamp forest that continues to be milled on private land in South Westland despite its much reduced area.

These forests, principally south of the Cook River, are under a Government-imposed moratorium on logging until 1990 when their destiny will be decided.
2.0 **Nomenclature**

Kahikatea is a member of the podocarpaceae family which comprises eight genera covering over 100 species. However, only four genera, with 17 species, are found in New Zealand: *Podocarpus* (Dacrycarpus), Podocarpus, Dacrydium and Phyllocladus. Species of all these genera are commonly found in New Zealand. However, the subgenus [Dacrycarpus](https://en.wikipedia.org/wiki/Dacrycarpus) grows only in New Zealand, and has kahikatea as its only "indigenous representative, but for the present it is preferable to treat [Dacrycarpus](https://en.wikipedia.org/wiki/Dacrycarpus) as a subgenus of [Podocarpus](https://en.wikipedia.org/wiki/Podocarpus)" (Salmon, 1980).

In his taxonomy of indigenous flora of New Zealand, Allan (1961) concluded on the basis of other botanists' research that:

"... it appears that *D. cupressinum* (rimu) shows much less affinity with [Dacrydium](https://en.wikipedia.org/wiki/Dacrydium), but a close relationship to, and should perhaps be placed with, [Podocarpus](https://en.wikipedia.org/wiki/Podocarpus). This conclusion agrees with the view that the anatomical features of the wood resemble those of [Podocarpus](https://en.wikipedia.org/wiki/Podocarpus)."

For the purposes of this paper, kahikatea will be referred to as *Podocarpus dacrydioides* as the correct botanical nomenclature, rather than *Dacrycarpus dacrydioides* with which it is sometimes confused.

While the species is also commonly referred to as "white pine", it will be referred to either as "kahikatea" or by its botanical name in this paper.
3.0 Natural History

Kahikatea occurs from the extreme north of the North Island to Stewart Island in the south. Although generally a lowland species with an altitudinal range to approximately 450 metres above sea level, it does occur in the Central North Island forests of Whirinaki and Pureora, with altitudinal ranges of up to 700 metres.

It occurs in almost all mixed forest associations, but the best developed stands commonly occur on alluvial wetlands. As Poweraker (1929) noted:

"The swampy areas are peopled by kahikatea (Podocarpus dacrydioides), a true swamp forest tree....but they are by no means confined to the river-flat swamps. Fine stands of this swamp forest tree are found on the borders of coastal lagoons..."

The mature kahikatea tree is typically tall and slender, straight and unbranched for the greater part of its height and carries only a small crown (Entrican, 1949); a maximum height of 59 m has been recorded, but the average tree is 24 m to 36 m tall (Entrican, 1949). Large fluted buttress roots, particularly in swamp areas, support the tree; elsewhere the trunk is generally symmetrical from base to apex.

Kirk (1889) eloquently describes a kahikatea forest:

"A virgin kahikatea forest affords one of the most striking sights in New Zealand forest scenery. Straight unbranched trunks rise one after the other in endless series; and in such close proximity that at a short distance no trace of foliage is visible except overhead....the naked symmetrical shafts tapering almost imperceptibly, appear to form dense walls which completely shut out every glimpse of the outside world".

The bark is greyish in colour, about one centimetre thick, and flakes off to leave elongated indentations in a vertical direction, which make the trunk distinct from miro and matai, whose indentations on the trunk are oval. Depending on the
climatic conditions and geographic location of kahikatea, mosses, ferns and other epiphytes may cover the bark.

The leaves are in two forms. In the juvenile stages of growth they are a deep bronze colour, about seven millimetres long, flat, but slightly bent at the tip, and arranged in a single row on each side of the branchlets, giving "a distinct feathery appearance" (Foweraker, 1929). On mature trees they are green and about two millimetres long, closely appressed to the stem.

Like other New Zealand podocarps, kahikatea is dioecious with the foliage bearing no distinguishing characteristics between male and female trees except during the fruiting season with the two sexes notably different in colour at this time (A. Reid, pers. comm.). The male bears small cones about two millimetres long which are faint orange when mature. A female tree is readily identifiable by the reddish berry-like fleshy receptacles which turn bright red when mature, and in which the naked seed rests.

Beveridge (1973) concluded, in a study of podocarp species in Pureora State Forest in the central North Island over seven years, that kahikatea shows marked periodicity:

"Kahikatea bears the heaviest seed crops and up to 14 000 sound seeds per square metre have been collected in one seed; once ovules are produced in quantity in late spring a good seed crop usually results. Very few or no sound seeds are produced in the two or three year intervals between good seed crops..."

3.1 Ecology

Although kahikatea was once widespread throughout New Zealand, all the major botanical and management studies into its ecology have been directed towards the stands of trees that exist in Westland: (Foweraker (1929), Wardle (1974), Reid (1977), and Smith and Burrows (1977)), although Beveridge (1973) has studied the regeneration of kahikatea and other podocarps at Pureora. The forests of Westland were dominated by high volume podocarp forests prior to commencement of sawmilling in the early 1900s.
The main rivers of the region follow troughs through morainic debris. These substantial layers of silts and gravels were deposited by Pleistocene glaciers. The surfaces are generally less than 1000 years old, and in those areas which have remained undisturbed by the deposition of material, deep, very wet, organic soils have developed (Wardle, 1974).

Reid (1977) terms the wetter, swampy sites "characteristic sites". Examples of these sites where kahikatea is to be found are:

(i) narrow tracts along the base of morainic hill country and flood plains;

(ii) small stands on river meander flood plains;

(iii) around the edges of lakes and lagoons; and

(iv) occupying abandoned river beds or "ox bow" lake formations.

Both Poweraker (1929) and Wardle (1974) record that the advent of mature kahikatea in its early stages was determined by the actions of river flooding onto flood plains which are naturally subject to silt and gravel deposition and subsequent colonisation by pioneer species.

Wardle (1974) observes that on gravel the initial pioneer species are characterised by Raoulia tenuicaulis, R. hookeri and Epilobium microphyllum with Cortaderia richardii colonising banks of deep silt and tall fescue establishing itself in wet depressions.

The next stage of succession is the establishment of a close herbaceous sward, comprising introduced and native grasses such as Yorkshire fog and Poa caespitosa. This sward, in time, gives way to low growing native plants, for instance Gunnera dentata and Cotula squalida.

This successional stage is followed by an invasion of shrubs. The dominant species are Coprosma propinqua and, on stony ground, totara. Thickets of these two species provide the forest shelter for seedlings of kahikatea and rimu.

On heavy silts, kaikomako dominates the initial forest stage, with Coprosma rotundifolia forming a shrub storey. Elsewhere, kamahi may dominate; kowhai can also provide shelter for kahikatea to become established.
In a study of Saltwater State Forest (Smith and Burrows, 1977) the occurrence of kahikatea was recorded on sites guided principally by the edaphic conditions. They found kahikatea growing in five different associations.

(i) **Rimu forest**: This forest is on an old post-glacial surface covered by medium to dense rimu forest. Kahikatea is to be found growing on the edges of streams.

(ii) **Kahikatea forest**: A complex kahikatea-dominant community occurs on recent soils along the Poerua River, on wet, fine sandy and silt loams.

(iii) **Kahikatea-rimu forest**: This forest type is influenced by drainage conditions and the extent of peat development which determine the varying proportions of the two dominant species.

(iv) **Kahikatea-matai-rimu forest**: This forest is not a homogeneous stand; the communities each differing in their structure and composition. These differences may be accounted for by the age of the soil surface and the depth of deposited alluvium.

On the oldest surfaces, it appears that regeneration of both kahikatea and matai are being limited by extensive root mat formations, whilst on younger surfaces kahikatea seedlings are common.

(v) **Scrub on river flats**: On several small river flats alongside the Poerua River, it was noted that the scrub was being invaded by kahikatea and, in places, matai.

Heavy rainfalls on the West Coast often lead to corresponding flooding in which a river may change course and flood a low-lying area of land containing kahikatea. Inundation of these areas and consequent deposition of silt alters the edaphic conditions surrounding the trees so that, depending on the severity of deposition, the whole stand may die to be succeeded, in time, by a new forest type (Poweraker, 1929).

Alternatively, the stand may only suffer a temporary set-back and produce adventitious roots, to enable the trees to adjust to the new edaphic conditions.
On the edge of swamps, lagoons and lakes, kahikatea trees tend, with increasing wetness, to decrease in size and become further apart. Thus the forest grades through a transition into swamp, which may be classified as either "fertile" or "infertile" (Wardle, 1974).

The fertile sequence, where swamp forms a transition zone between forest and the water of a lake or slow-moving river, is most commonly found. On these sites flax is normally dominant in the swamp zone.

Infertile swamp conditions are a result of impeded drainage caused by hardpans and the build-up of organic material on older surfaces. The height and complexity of vegetation decreases away from drainage channels - probably reflecting poor soil conditions and lack of nutrient inputs (Wardle, 1974).

In fertile conditions, due largely to an influx of nutrients by moving water, gallery forests of kahikatea follow the large streams. These forests have been described (Smith, pers. comm.) as "floating forests" and are New Zealand's equivalent of the cypress swamps of the United States. The last examples of this forest type - once widely found throughout New Zealand - remain only in South Westland and include areas within Karangarua, Hunts Beach and Bruce Bay State Forest and Westland National Park. These forests, supported by large spongy buttress roots, grade into infertile swamp via vegetation dominated by silver pine, bog pine, manuka and mountain toatoa. Typically there is a dense ground cover of Astelia grandis, sedges, grasses and ground ferns. With increasing distance from the streams kahikatea decreases in size and numbers, eventually being replaced by manuka.

Therefore there are two completely distinct types of kahikatea forest that must be recognised in any discussion on the present area of kahikatea. The two forest types are:

(i) kahikatea found on alluvial river flats and in mixed forest associations, such as those stands noted by Beveridge (1973) in Pureora; and

(ii) dense swamp kahikatea, with gallery forests of the species as observed by Wardle (1974).
It is the lack of recognition of the particular site conditions occupied by kahikatea that has caused disagreement over the remaining area of kahikatea.

3.2 Regeneration and Seed Dispersal

There has been a great deal of attention directed towards the regeneration of podocarps in New Zealand. There are two significant patterns of regeneration suggested:

(i) where the mature podocarp stands are part of a succession, and in which the various stages should be easily recognisable; or

(ii) where mature stands of trees form a climax community, and the forest contains adequate numbers of younger plants or a mosaic of different age classes (Wardle, 1974).

Wardle (1974) noted that, although the river flat successions which lead to young forest containing various densities of kahikatea are identifiable, the stands of dense kahikatea at river mouths do not have appropriate areas of seral forest with young kahikatea. In the main valleys and their lower reaches Wardle believes that podocarp regeneration is inadequate and the indications are that these areas will revert to hardwoods. Within dense stands of kahikatea it was observed that there was a lack of small seedlings and that in open gaps created by windthrow or natural mortality ferns and small hardwood were dominant.

It is suggested by Wardle (1974) that the failure of podocarps to continue beyond the first generation (that is, up to 1000 years) is the result of podsolisation and gleying causing decreasing soil fertility, with rimu replacing kahikatea and matai (see also Chavasse, 1971). In contrast, Smith and Burrows (1977) reported substantial regeneration of kahikatea throughout Saltwater State Forest, an area that:

"...contains a complete time sequence of soils which, in reverse, is represented by the sequence from youthful (one year old) to old soils, terminating in peat bogs on the old flood plains and gley podzols on terraces probably more than 10 000 years old. The sequence of vegetation corresponding to the soils is equally well represented."
One of the major features of the area is the wide diversity of different kahikatea communities it contains within a relatively small area.

Beveridge (1964), in his study of the "dispersal and disposal of podocarp seed", records that a mature individual kahikatea yields 815 kilograms of ripe seed, and receptacles yielding 136 kg of clean, sound seed. Kahikatea thus provides a substantial food source for fruit-eating birds which subsequently act to disperse the seed. The most active dispersers are the New Zealand pigeon, tui and bellbird. These birds swallow both the fleshy receptacles and seed, but digest only the pulp, the seeds passing through the digestive tract intact.

During the fruiting season, pigeon droppings contain almost entirely podocarp seed; large droppings containing up to 100 kahikatea seeds. After feeding, pigeons may perch in emergent trees near their food source. The seeds dropped beneath these trees may contribute to the resulting mosaic pattern of uneven age stands.

Beveridge notes the dispersal of kahikatea seed, particularly by tuis, as an illustration of seed dispersal:

"...the forest edge was sprinkled with sound kahikatea seed deposited by flying birds. These seeds were scattered or in droppings containing up to five seeds..."

Despite this dispersal and widespread germination of kahikatea, most of the seedlings die in the first two summers. In quadrants established beneath parent trees, those seedlings that survived grew only 5 cm in five years (Beveridge, 1973), recruitment being limited by leaf litter and suppression of plant growth.

Within Pureora Forest, Beveridge (1973) concluded that regeneration is cyclic. It begins with the windfall of an over-mature podocarp, which is followed by a dense invasion of tree ferns which inhibit podocarp recruitment. In time there is epiphytic growth of such hardwoods as kamahi on the tree fern stems. These hardwoods eventually suppress and cause the death of the ferns, to become a suitable perching place for pigeons and other birds. These birds pass viable seed which, given suitable conditions such as when the hardwood canopy thins and a suitable seed bed is available, will germinate and can develop into sapling groups.
In virgin forest, where competition from ground ferns and broadleaved species is not severe, seedlings of kahikatea may attain a height of one or two metres over a period of 20 to 50 years. Of all podocarp seedlings 1.5 to 3 m high, which were artificially released, kahikatea had the fastest growth rates, with an annual height increment of 7 to 30 cm (Beveridge, 1973).
4.0 General Characteristics

Kirk (1889) provides an early description of kahikatea:

"In many logs both heartwood and sap are white, the former being only distinguished by its greater hardness and density; but usually the heartwood is of a yellowish-brown. Trees are often met with which produce a yellowish timber with a stouter grain than usual, and of more durable quality when exposed."

Some sixty years later, Entrican (1949) described kahikatea as having a timber which "is fine and even in texture and straight grained."

Kahikatea is not generally used for decorative purposes, being usually painted or stained. In the past it has been used as a structural timber, despite its low strength when dried, and its susceptibility to attack by borer (NZFS, 1979). Kahikatea is a wood which is easily worked and its resistance to splitting allow it to be machined and turned without difficulty. But it was the value to the dairy industry of its "non-tainting properties" (Entrican, 1949) which led to exploitation and eventual scarcity.

4.1 Past Users of Kahikatea: The Maori

The Maoris were the earliest users of kahikatea, collecting and eating the fruit of the tree:

"The people brought large baskets full of berries of the kiakatora (kahikatea) for sale...These berries are very like those of the yew, but not slimy; they are good tasting, and form a part of the food of the natives during the season in those places where the trees are abundant; they are produced in such quantities as to give the trees a scarlet appearance."

(Best, 1942)
The fruit was collected by climbing the trees, and putting the fruit into baskets which, when full, were lowered to the ground by a cord and emptied.

The finest pigment for tattooing was made from soot obtained by burning the hard, resinous heartwood. Other uses included the manufacture of weapons which required strength and durability.

4.2 Early European Uses and the "Butter Box Era"

The earliest European recognition of kahikatea and its potential was made in 1796 by Captain James Cook and Joseph Banks:

"...the banks of the river (Thames) were completely clothed with the finest timber my eyes ever beheld...every tree as straight as a pine and of immense size...The woods were very swampy..."

(Hooker, 1896)

Captain Cook recorded the first measurements of kahikatea in New Zealand, writing in his journal:

"...we had not gone a hundred yards into the woods before we found a Tree that girted 19 feet 8 inches, six feet above the ground, and having a Quadrant with me, I found its length from the root to the first branch to be 89 feet, it was as Straight as an Arrow and Taper'd but very little in proportion to its length. We saw many others of the same sort, several of which were Taller than the one we measured, and all of them very stout..."

(Reed, 1969)

Probably the earliest recorded use of kahikatea is by Kirk (1889), who noted the "good condition" of a house, constructed in 1850 of kahikatea, thirty nine years later. However, Kirk did express some doubts over the durability of the timber.
Other uses of kahikatea recorded by Kirk were the manufacture of furniture, large panels and dado work, together with use for packing cases, tallow casks, and boat building.

With the clearance of much of New Zealand's forests, and their conversion into pasture, the growing dairy industry became reliant on kahikatea for its non-tainting properties when used for butter boxes to the extent that the Annual Report of the Department of Lands (1908) noted: "the forests of pure white pine that used to exist on the extensive swamplands of the Auckland District have almost gone..."

The 1913 Royal Commission on Forestry expressed concern about the future of kahikatea, noting:

"How long the white pine will last at the present rate of consumption we cannot say, since we possess no reliable data as to the area occupied by that tree."

The Commission also considered the possible prohibition of the export of kahikatea, but rejected the proposal:

"...we are of an opinion that a substitute for white pine can be found, first of all in an imported article and later in a timber grown in New Zealand. Were such an export to be forbidden the West Coast Timber Company shows that 50 percent of the log would remain in the sawmillers' hands."

Only 40 percent of the sawlog was being used for butter boxes, in 12 inch and 14 inch boards. The Commission (1913) noted that 60 percent of the log would be wasted in New Zealand, while the whole log was used in Australia.

Concern was again expressed in 1918 regarding the exploitation of kahikatea; the Annual Report of the Department of Lands (1918) stating: "considerable public interest has been manifest in discussing the importance of conserving New Zealand timbers, more especially as regards kahikatea which is fast becoming scarce."
So scarce had the timber become that, by 1919, it was "impossible to obtain adequate supplies" (Annual Report, Department of Lands, 1919). Measures were undertaken through the Board of Trade to limit the export of kahikatea to 40 percent of total production, a proposal that met strong opposition from sawmillers.

By 1924, the podocarp forests of the King Country and those beside the Main Trunk railway had reached their nadir: "the exhaustion of the white pine resources...driving millers far afield." (Annual Report, State Forest Service, 1924).

In 1925, despite imports of spruce and hemlock butter box shooks from Sweden, Canada and the United States, kahikatea reached new high price levels in New Zealand. The Annual Report (1925) of the State Forest Service deplored the fact that Australian manufacturers appreciated the qualities of this timber (kahikatea) to a greater extent than our own producers.

In an attempt to cut the wastage of indigenous timber, a timber sales policy was introduced in 1926 to: "husband and conserve and use our remaining forest wealth with the greatest care." (Annual Report, State Forest Service, 1926). Among the objectives of this policy were:

(i) a desire to provide continuous and stable supplies for established industries; and

(ii) stimulation of sawmilling operations in forest regions where the public interest and good justified them.

In 1927 increased competition from North American and Baltic timbers, together with low dairy exports from Australia, caused the lowest exports of kahikatea from New Zealand since 1900. However, the use of Baltic spruce boxes was to meet with opposition, due to tainting: "a fact which English importers have not been slow to appreciate." (Annual Report State Forest Service, 1926).

The multiplicity of sizes of butter box appearing on overseas markets was also considered to be detrimental to the marketing of butter and attention was directed towards developing a standardised box size in 1930.
Due to the superiority of kahikatea, an increase of its use was anticipated (Annual Report, State Forest Service, 1930). The Annual Report stated: "White pine undoubtedly yields the best locally manufactured case, but the prices which the white-pine producer can secure for his timber, both for export and for other domestic use, are so much higher than the case-manufacturer can pay; he (the white-pine producer) is only interested in the trade as an outlet for his offcuts and curs..."

As a result of increasing depletion of kahikatea in the North Island attention was given to substitutes, so that by 1933 Pinus radiata was beginning to replace kahikatea for cheese crates. However, the necessity of applying a casein coating on the inside of exotic timber boxes and the associated costs meant that "the process will not become of great commercial significance until white pine supplies are further depleted." (Annual Report, State Forest Service, 1933).

The imposition of the Products Export Amendment Act 1935, in which "timber" was included, empowered the Government to control the grading and marketing of all timber for export. Following pressure by dairy interests and butter box manufacturers for the control or prohibition of the export of kahikatea as an essential raw material for the butter industry, the Government instituted the following policy (Annual Report, State Forest Service, 1936):

"(i) the conservation of all State-owned supplies of white pine for local essential uses such as butter boxes, tallow casks; and

(ii) the limitation of exports of white pine to essential Australian requirements for butter boxes."

The kahikatea resource of South Westland, containing 70 percent of total New Zealand supply, was to be retained for local requirements. It was also stated: "as in the past every encouragement also will be offered for the use of exotic timbers as substitutes for white pine...so that white pine may be conserved for the more essential purposes of butter boxes and tallow cask manufacture."

In spite of the attempts in 1936 to plan ahead for the use of kahikatea, there continued to be a shortfall in supply in 1937, due: "to the unexpected expansion in local butter production and to the rapidity with which white pine supplies have
diminished not only in the North Island but also in the South Island. Because of this, export control was reinstated, and a detailed survey showed a drastic reduction in previous estimates. Thus the policy of export control attempted to assure "the butter industry of one of the most essential packing materials."

The Annual Report of the State Forest Service (1937) recounts: "that the overestimation of the white-pine resources in the past on private lands arises from the fact that the species grows on rich river-flat lands, and whereas hitherto large stretches of forest on such lands were regarded as being wholly white pine, the more recent appraisals of previously inaccessible areas have limited the species to a mere fringe along the river-banks..."

With demand exceeding supply dairy factories were reduced to one day's supply of butter boxes in some parts of the country causing the Government to create a Central Authority for the purpose of regulating box supplies and disposing of them at a uniform cost to all dairy factories. The New Zealand Dairy Board, with powers conferred on it by the Agricultural Emergency Powers Amendment Act 1936, was to operate an export butter box pool, charging dairy factories a standard price for boxes. The introduction of price control was explained in the State Forest Service Annual Report (1937) as having the following effect:

"Had it not been for the enforcement by Government of its policy that not only should local demands for white pine have precedence over export, but that New Zealand's consumers of white-pine should not be required to pay export parity but only a fair return to the producer, the dairy industry would have been compelled to pay, for boxes of a quality comparable with those now being manufactured, at least 3d per box more than during last season..."

But it was: "the outstanding merit of white pine as a butter box" (Annual Report, State Forest Service, 1937) in competing with overseas markets, rather than any concern over the future of kahikatea, that motivated these measures.

The fall in production of kahikatea (Figure 1) by 1940 was a reflection of Government policy to meet essential local demand. As kahikatea rose in price due to market forces and shortages, radiata pine began to replace it in the manufacture of all containers except butter boxes. Other native timbers such as rimu, miro and matai were also examined for their potential uses.
Source: Years before 1951, Industrial Production Statistics, Department of Statistics; 1951 and later years, New Zealand Forest Service.
Despite the decline by 1940 of New Zealand's forest resource through wilful clearing and the demise of both kauri and kahikatea as forest, the Annual Report of the State Forest Service, (1941) stated:

"Of paramount importance is public recognition of the fact that by far the bulk of the virgin forests are completely unproductive in that trees are over-mature...
Conservation as applied to forestry has been defined as the preservation of forest by wise use...the major objective of forest policy - that of supplying the Dominion - can only be achieved by bringing every acre of land into maximum production and by having available the entire standing timber resources of the indigenous forests..."

Radiata pine by 1941 was the accepted standard timber for the manufacture of containers other than butter boxes and tallow casks. The North Island was still heavily dependent on supplies of kahikatea and rimu from the South Island and, in particular, Westland for these latter uses.

Forced by wartime need, kahikatea continued to be regulated, so that by 1943 the New Zealand Gazette (p.352) required "kahikatea or white pine timber be used only for the manufacture of tallow casks or butter boxes or ship's dunnage, except with the consent of the Timber Controller."

Shipping problems to the North Island compounded the problem of supply and in 1943 regulations were instituted to obtain kahikatea from privately-owned stands in the North Island. Supply problems were to ease by 1945 with the importation of kraft fibre boards from the United States which, it was noted, had: "the inability to hold their shape and rigidity." (Annual Report, State Forest Service, 1945).

In 1946 box factories were beginning to close down as a result of: "the approaching exhaustion of accessible white-pine supplies" (Annual Report State Forest Service, 1946) and there was an increasing dependence on kraft fibre board containers. The latter were eventually to replace kahikatea.
By 1950 demand for building timbers following post war prosperity resulted in kahikatea being used for framing and cladding, together with beech and tawa. Despite the virtual non-existence of large stands of kahikatea, the Forest Service Annual Report of 1950 observed: "it is fortunate that a steady demand for other purposes has followed the virtual cessation of its use by the dairy industry." Three years later forest policy maintained that the purpose of an exotic forest resource "was not merely to avoid the early exhaustion of the virgin indigenous softwood resource, but also reduce the annual cut to a figure at which a sustainable...supply of indigenous softwoods would be available..." (Annual Report New Zealand Forest Service, 1953).

By 1955 increases in Pinus radiata production, had supplemented kahikatea the Forest Service Annual Report warning that producers had: "little prospect of recapturing a share of the general box-making and concrete boxing trade unless they are prepared to sell their products at prices lower than radiata pine."

"The butter box era" could be described as one of mismanagement on the part of forest administrators and politicians due to their lack of vision towards the future and, despite recognition by the Royal Commission on Forestry (1913) of the impending shortfall in supply, continuing exports of kahikatea until 1936.

The era was one in which the pioneer ethic dominated, and there was a general feeling that the timber resources were infinite and could be squandered, a sentiment typified by the Royal Commission (1913):

"Were there to be a restriction on the export of white pine, then the sawmiller would cease to convert the white-pine trees in his rimu forest, and they would remain only to be eventually burnt in the course of settlement."

The rationale behind the milling of kahikatea was stated in the State Forest Service, Annual Report of 1947, which explained that it was not only necessary for timber supply, but for land use:

"The problem is a simple one, therefore. It is merely dairy farming versus white pine forestry; and there can be little doubt about the decision. Dairy farming demands
such land in the national interest and commercial kahikatea forests are therefore impossible."

(Annual Report, State Forest Service, 1947)

Today, milling of kahikatea still occurs on Maori, private and State forest land, in spite of its scarcity as a forest type, primarily for timber supply.

4.3 Present Uses and Alternatives

On State forest land the management and use of kahikatea and other native woods is guided by the "Management Policy for New Zealand's Indigenous State Forests" (1977). Yet no policy exists for land administered by other Government agencies such as the Department of Lands and Survey or lands in other tenure.

Despite its stated scarcity throughout New Zealand (Salmon (1980), Morton (1981)), kahikatea is still being logged and used for a large number of purposes for which alternative timbers are available. The major uses are outlined below, together with possible alternative exotic timbers.

Weatherboards: Because of diminishing supplies of other indigenous timbers (principally kauri, mātai and rimu), kahikatea has become a source for weatherboards as it can be easily cut in long, straight lengths. It is easy to nail and has good durability if given preservative treatment.

Locally grown exotic timbers such as radiata pine or artificial cladding products on the building market may be used as an alternative to kahikatea.

Scaffold planks: Kahikatea, because of its smooth wearing surface, light weight and clear lengths is used in substantial quantities for scaffold planks.

An alternative timber for this purpose is Douglas fir or laminated radiata pine.

Boat building: With its good bending and gluing properties, its strength to weight ratio and its availability in long, clear lengths, kahikatea has become a substitute for kauri.
As supplies of kahikatea become scarcer, it will no doubt be substituted by kauri grown on a sustained yield basis or kahikatea grown on the same principle.

**Boxing:** Building grades of kahikatea are used as framing, beehives, boxing and bath tubs. The use of large quantities of kahikatea for concrete boxing on the Upper Waitaki power project resulted in criticism of this end use, with the suggestion that radiata pine would have been a better timber to use.

However, "as boxing (kahikatea) is superior to radiata pine, in that because its knots do not drop out, it can be used four or five times, compared with once only for radiata". (A. Reid, pers. comm.).

**Other uses:** Because of its non-tainting properties kahikatea is used for rods for cots, clothes horses, cheese curing boxes, butchers' boards, toys, jam spoons, adzed furniture, and venetian blind slats. With its good machining properties, kahikatea is used for mouldings, joinery, turnery and toy manufacture.

It is possible that exotic timbers such as European beech and Norway spruce could be used for the same purposes, as past use shows that they all have similar qualities to kahikatea.

Boon (1980), in an unpublished report stated that in 1978/79 the six major producers in Westland produced 90 percent of the total volume of kahikatea. In this report the opinion is offered that the large mills "are not as proficient in cutting for grade or as efficient in terms of conversion as the small, specialist mill." The latter were achieving conversions of 69 to 71 percent, with grade recoveries of 70 percent clears and 30 percent building grades. In one month their clear recovery was 92 percent. In contrast, high production units are only obtaining recoveries of 54 percent clear and 46 percent building grades.

The potential uses of kahikatea have been described by one sawmiller as unlimited (Boon, 1980), particularly when considering export markets. As Boon (1980) has written:

"Kahikatea is a special purpose species but as with all such species there are alternatives which may not be as good but good enough for the job."
4.4 Means of Reducing Demand for Kahikatea Timber

Apart from substituting exotic timbers for kahikatea, one means of reducing consumer demand would be the imposition of price control on the wood to increase the price of the end product. The price must be artificially increased as the present price places no significant constraint on demand.

If the price is to be artificially increased (possibly by some form of price control) then some of the surplus revenue generated should be used to fund research into the silvicultural management and artificial establishment of the species. However, given that price control is normally used to hold or deflate prices rather than increase them, a direct levy may be more appropriate.

Another means of obtaining a reduced demand would be the imposition of a quota to ensure the viability of the resource on a sustained yield basis. McDermott Associates (1981) wrote in the West Coast Resource Development Study:

"Utilisation of the commercially viable indigenous forest to provide mainly rimu and kahikatea is proceeding at a rate much higher than the forests can withstand if satisfactory long-term yields are to be sustained, and if the Forest Service management objectives to perpetuate them (State indigenous forests) both as natural forests and managed stands are to be met."

In view of this statement a re-evaluation of the timber resource and present contract periods would be appropriate until exotics for substitution become available. This is particularly critical in view of the fact that:

"...economic accessibility depends on the existing market prospects and prices of indigenous timber, especially kahikatea, and a significant increase in the value of the timber could see the 584 000 m³ south of the Cook River available to the southern mills."

(McDermott Associates, 1981)
Therefore, as this report (McDermott Associates, 1981) notes, the Management Policy for New Zealand's Indigenous State Forests (1977) oriented toward raising the value and price of indigenous timber may in the long term make utilisation of these forests feasible. It is essential that any increase in returns should not benefit the sawmiller and assist him to better exploit the remaining forests, but should go into the establishment of an exotic estate, or into silviculture of kahikatea and other indigenous species.

Before the logging moratorium is lifted in 1990 a review of the Management Policy for New Zealand's Indigenous State Forests (1977) will be necessary if the policy is indeed having this effect on the pricing structure.
5.0 Implications for Wildlife of Milling Kahikatea

In 1878, the Annual Report of the Department of Lands stated:

"...forest...must be felled and burnt off to make way for grass paddock - indeed this process of destruction is in operation every day."

The forests were seen as a hindrance to land development, and fire and the saw were seen as the means to eliminate them. A philosophy:

"...that under all circumstances, one blade of grass has, with more than two trees long prevailed."

(Masters, Holloway and McKelvey, 1957)

Destruction of the forests was readily acknowledged as early as 1902 when, in the Department of Lands' report, Henry Matthews, Chief Forester noted:

"Owing to the rapid denudation of our native forests it is necessary that measures be at once taken to conserve and protect our timber..."

The Commissioners of Crown Lands in 1905 observed in their report, "The Timber Industry of New Zealand", that:

"...every year sees the destruction of bush all over the country through fires and clearing operations, whilst output will probably increase, the supply on hand may be reckoned to last seventy years at the most."

In 1907, the "Report on the Timber Industry in New Zealand" stated:

"As is well known the Crown has for some time past parted with its forest lands by way of sale, and consequently is not now able to control the felling and destruction of the remaining forests to any great extent."
Despite noting that "it appears certain that the supply is not likely to last beyond the seventy years estimated in 1905, and will possibly fall short of this period...", the report (1908) typifies the attitude of the era with the rationale that:

"...the process of felling and removing milling timber from the land largely helps open it up for settlement purposes, and thereby assists in some measure the work of colorisation."

The Royal Commission on Forestry (1913) also expressed a commonly held attitude of this period in its report, noting:

"Since no land is more suitable for occupation than that of the white-pine swamps, when drained, their value in this regard is a strong plea in favour of the removal of the trees forthwith."

The result of this unprecedented forest clearance immediately following colonisation in New Zealand, combined with predators such as cats, rats and dogs, led to the decline in numbers and species of birds which nested on or near the ground, had limited flying ability, and little fear of these predators. (Coker and Imboden, 1981).

Today the threat to native birds and other fauna still exists, a consequence of continued forestry operations, land development, introduced predators and man. The significance of kahikatea to native birds (including the tui, kaka and parakeet) and the repercussions of habitat modification are stated by Coker and Imboden (1980):

"Kahikatea and other podocarps, which often surround swamps, are an important food source for fruit eating species. While the swamps are not usually considered vital to the existence of forest birds...they are essential to the continued presence of some species by providing a significant part of the diet at certain times of the year."
Kahikatea has generally been associated with fruit-eating birds such as the New Zealand pigeon. However, the edaphic conditions that kahikatea can occupy mean that the species is a valuable habitat and nesting site for fernbirds, marsh crake, spotless crake and the white heron, amongst other native birds. (Coker and Imboden, 1980).

These, and other birds, face loss of their habitats through land reclamation and drainage of swamp areas, wetlands and forest. Coker and Imboden (1981) believe 160,000 hectares of wetlands were drained between the mid 1950s and mid 1960s, and that the introduction of interest-free and principal-free Land Development Encouragement Loans may have actually accelerated the rate of swamp drainage. However, this land development persists, despite suggestions of the effects on birds from a loss of habitat. In 1981 Coker and Imboden noted the drainage of Kongahu Swamp, once one of the largest (c. 800 hectares) in North Westland, and commented:

"The swamp was an important habitat for fernbird, bittern, crakes, pukeko and some water fowl. Banded rail have been located nearby."

A reserve of predominantly kahikatea, totalling 51 hectares, is all that has been set aside for nature conservation.

Chavasse (1971) notes with reference to land clearance operations:

"There is no agreement about the best form of use for most of the flood-plain soils. When fully developed they support highly productive farms. Many of the peaty areas, however, are excessively swampy and difficult to drain and would be better under kahikatea forest than under grass."

The South Westland Management Proposals (1980), unlike the South Westland Land Use Study (1977) do not advocate clearance of the forest, observing:

"The Forest Service believes that there is not a strong case for the conversion of existing forest to farmland...The better land for farming is also the best land for podocarps, particularly kahikatea which favours relatively fertile sites."
Table 1, "Development and Maintenance Costs for West Coast Agricultural Land", shows the high cost of land development.

Threats to stands of kahikatea are also being caused by cattle grazing leading to the trampling of seedlings and disturbance of nesting sites. Invasion of swamplands and forests by weeds following "development", particularly by gorse and blackberry, are also seriously threatening the potential of many birdlife habitats.

It is not only bird habitats which are at risk from land development and forestry operations, but also those of fish, particularly galaxiids. McDowall (1978) describes the giant kokopu as rare; a consequence of loss of suitable habitat such as logs, trees, roots, flax and raupo.

Another fish whose existence may be in question as a result of the clearance of kahikatea and swamp drainage is the brown mudfish. McDowall (1978) comments:
<table>
<thead>
<tr>
<th>DEVELOPMENT COSTS (TOTAL)</th>
<th>Virgin Bush</th>
<th>TYPE OF EXISTING VEGETATION</th>
<th>Swamp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Scrub</td>
<td>Pakihi</td>
</tr>
<tr>
<td>Clearing and cultivation</td>
<td>650</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>Drainage</td>
<td>-</td>
<td>-</td>
<td>50</td>
</tr>
<tr>
<td>Fencing</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Lime</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Seed</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Weed control</td>
<td>50</td>
<td>170</td>
<td>170</td>
</tr>
<tr>
<td>Water supply</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Tracking</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Buildings</td>
<td>330</td>
<td>330</td>
<td>330</td>
</tr>
</tbody>
</table>

| TOTAL DEVELOPMENT COST (ANNUAL) | 1,700 | 1,470 | 1,370 | 1,580 |
| MAINTENANCE COSTS*++            |       |       |       |       |
| Fertiliser                     | 42    | 42    | 42    | 42    |
| Lime                           | 15    | 15    | 15    | 15    |
| Equipment                      | 30    | 30    | 33    | 51    |
| Weed Control                   | 10    | 10    | 10    | 10    |

| TOTAL MAINTENANCE COST         | 97    | 97    | 100   | 118   |

Note:++ Taken as 60 percent of estimated requirements to reach maximum output to be consistent with production scenarios. It is significant that the 1978 average application was less than half the estimates of maintenance requirements (MAF Fertiliser Statistics, 1980).

(McDermott Associates (1981))
"(Brown mudfish were) almost certainly once very widespread in the rimu-white pine forests in the Wairarapa and still common in Westland. It seems that these forest swamps were probably the original habitat of the brown mudfish...it is certain that the species has been extinguished in many areas..."

There is insufficient knowledge to record the loss of other forms of fauna, such as invertebrates, which may have occurred as a consequence of the modification and exploitation of areas of kahikatea.

The loss of endemic litter insects is often overlooked in any forest clearing operation. Replacement of beech forests in Westland with an exotic estate shows a loss of at least 50 percent of all endemic litter insects, whilst more detailed studies indicate a more appropriate figure may be 90 percent (G. Mew, et al, 1977). It is possible a similar situation pertains in conversion of kahikatea forests.

Bats are reported to have been sighted (pers. comm. G. McSweeny) in stands of kahikatea at Hunts Beach, alongside the Poerua River, and elsewhere. As kahikatea matures, holes begin to form within its trunk, and it is believed that these provide a roost for the bats. Although the species of bat has not been identified, they are thought likely to be the long-tailed bat (pers. comm. M. Daniel).

The remaining stands of dense kahikatea on the West Coast are the last examples of this forest type left in New Zealand which illustrate a succession of habitats from wetlands to forests:

"Most of the plants and animals that form these communities are found nowhere else in the world. Together they are part of a diverse and irreplaceable reservoir of continually evolving genetic material which is important for longterm wildlife conservation."

(Coker and Imboden, 1980)

However, as recently as 1981 an editorial in the New Zealand Journal of Forestry, which is produced by the New Zealand Institute of Foresters, argued against the
concept of a national park from the mountains to the sea in South Westland which would have preserved in perpetuity forests containing some kahikatea and other podocarps, stating:

"We have an obligation to future generations of New Zealanders not to lightly put aside that which may well be of inestimable value to them, a secure and properly managed source of special purpose timbers."

(NZ Jl For. 26(2): 124)
6.0 Artificial Establishment of Kahikatea

The 1903 Annual Report of the Department of Lands records trials at the Ruatangata Nursery north of Whangarei for the establishment of kahikatea and the transfer of the seedlings to the Puhipuhi plantation at Whakapara. The Annual Report of the Department of Lands in 1906 observes:

"Small lots of Podocarpus dacrydioides...were dealt with at an average cost of 4 shillings per thousand. It is essential for success that trees so treated be well shaded for at least three months. They require to be lifted and classed and the majority grown in the nursery for another year, by which time they make splendid roots and are well fitted to bear transplanting..."

By 1911 some 4200 seedlings of kahikatea had been planted at Puhipuhi Plantation. However, that year a fire swept through some of the area and the eventual fate of the trees is unrecorded in subsequent Annual Reports.

The next record (Field, 1932) of artificial establishment of kahikatea is in 1932 in the Manawatu, where it was grown in a Palmerston North nursery prior to the planting at Opiki of some 750 trees with an average height of 40 cm. Following attack by deer the trees showed good recovery. Field (1932) concluded that: "height growth under optimum conditions and attention is, up to four years, equal to that of the better class of exotic pines, such as Pinus ponderosa and Pinus larchio."

Since this trial, of which little is recorded of its silvicultural management, others, such as Beveridge (1973) at Pureora State Forest and Steward (1980) in Pureora and Horohoro State Forests, have conducted trials within forests with kahikatea and other podocarp seedlings.

Steward (1980), in enrichment trials of podocarps, including kahikatea, on the sites of logging operations and gaps created in patches of dense tree ferns, found that: "although the survival of kahikatea and totara has been good, the lack of releasing has allowed wineberry to collapse beneath tangles of lawyer...and smother and distort many of the planted seedlings."
These trials (Steward, 1980) and later comparison of seedlings at the two sites indicated that seedlings released from undergrowth yearly for four years still had a survival as high as 96 percent at Horohoro and although averaging 88 cm in height at planting are almost 100 cm taller at four years than kahikatea in the Pureora trial at the same age.

Kahikatea planted in 1961 at Pureora on logged sites had by 1964 more than doubled their original planting height of 38.4 cm, with survival dropping to only 87.2 percent. In 1976 survival had declined to 63.1 percent, but height had increased to average 189.2 cm. Following releasing in 1976, and subsequent measurement in 1980, the mean height for kahikatea was 402 cm.

This trial concluded the necessity of releasing to assist growth and survival. Steward suggests that on optimum sites at Pureora, rimu, kahikatea and totara have comparable growth rates and can reach heights of four to six metres, 20 years after planting.

6.1 Silviculture

A trial into the silvicultural management of kahikatea was initiated in 1980 by Mr C. Gleason of the Forest Research Institute, on the property of Mr F. Hahn at Totara Flat in the Grey Valley. The trial, on alluvial soils, is divided into three blocks involving less than one hectare in total.

The trials consist of three blocks:

- Block 1 - untreated and fenced
- Block 2 - untreated and unfenced
- Block 3 - treated and fenced

The forest was originally cleared for farming, leaving 87 hectares which regenerated to the pole stand which is estimated to be 55 years old.

Prior to thinning, the treated block contained approximately 4000 stems per hectare. This was reduced by thinning to about 400 stems per hectare. It is believed that further thinnings could be achieved to obtain between 200 and 300 stems per hectare, to boost diameter growth.
However, as Masters, Holloway and McKelvey (1957) note with regard to the silviculture of podocarp pole stands:

"These stands cannot contribute significantly to the future supply of podocarp timbers. They are of great value for research purposes... It would be premature, and misleading, to attempt any forecast of future increments. It would in fact be premature to attempt any statement as to the probable ultimate extent of podocarp re-establishment... Improvement of this can only be through discoveries yet to be made in the field of artificial re-establishment of podocarp forests, employing fast-growing strains yet to be discovered."

It is doubtful whether such a trial would give the same results in South Westland where costs involved in providing access to the forest, logging and removal of trees, make the operation unprofitable to sawmillers (McDermott Associates, 1981). Table 2, Forestry Harvesting Costs, gives an indication of the relevant costs of timber extraction.

Unlike the terrace rimu forests of South Westland, the kahikatea swamp forests will require a more specialised type of logging operation due to their "floating" nature. Wardle (1974) cites an example in Karangarua State Forest where rimu is standing on semi-liquid peat over three metres in depth.

The South Westland Management Proposals (1980) omit any mention of these site conditions or the possibility that present logging techniques and silvicultural practices could be inappropriate to this type of forest. Nor is any comment made on hydrological studies that should be undertaken on such sites (swamp forest), and the effects of logging, if sustained yield forestry is to be practised, on other forest values such as natural regeneration and wildlife.
TABLE 2: FORESTRY HARVESTING COSTS ($/m³)

<table>
<thead>
<tr>
<th></th>
<th>Forest Roading</th>
<th>Plant and Equipment</th>
<th>Labour</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncommitted beech (North Westland)</td>
<td>2.00</td>
<td>6.33</td>
<td>4.97</td>
<td>13.30</td>
</tr>
<tr>
<td>Exotic</td>
<td>0.50</td>
<td>5.97</td>
<td>4.69</td>
<td>11.16</td>
</tr>
<tr>
<td>Podocarps:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buller</td>
<td>2.00</td>
<td>8.44</td>
<td>6.63</td>
<td>17.07</td>
</tr>
<tr>
<td>North Westland</td>
<td>2.00</td>
<td>8.23</td>
<td>6.47</td>
<td>16.70</td>
</tr>
<tr>
<td>South Westland</td>
<td>2.00</td>
<td>8.62</td>
<td>6.78</td>
<td>17.40</td>
</tr>
</tbody>
</table>


7.0 Legislation

The following legislation can provide protection for areas of indigenous forest including stands of kahikatea. Protection could range from the highest status possible, that of a sanctuary or national park, to partial protection within a State forest. The various statutes have provision for the setting apart and designation of areas of land for specific purposes. These are outlined below.

<table>
<thead>
<tr>
<th>Statute</th>
<th>Administering Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Forests Act 1949</td>
<td>New Zealand Forest Service</td>
</tr>
<tr>
<td>(ii) National Parks Act 1980</td>
<td>Department of Lands and Survey</td>
</tr>
<tr>
<td>(iii) Reserves Act 1977</td>
<td>&quot; &quot; &quot; &quot; &quot; &quot; &quot; &quot;</td>
</tr>
<tr>
<td>(iv) Land Act 1948</td>
<td>&quot; &quot; &quot; &quot; &quot; &quot; &quot; &quot;</td>
</tr>
<tr>
<td>(v) Queen Elizabeth the Second National Trust Act 1977</td>
<td>Queen Elizabeth the Second National Trust</td>
</tr>
<tr>
<td>(vi) Town and Country Planning Act 1977</td>
<td>Local authority</td>
</tr>
</tbody>
</table>

7.1 The Forests Act 1949

This Act makes provision for the Forest Service to administer:

"All State forest land to ensure the balanced use of such land, having regard to the production of timber or other forest produce, the protection of the land and vegetation, water and soil management, the protection of indigenous flora and fauna, and recreational, educational, historical, cultural, scenic, aesthetic, amenity, and scientific purposes" (s.14(a))
The Forests Act 1949 allows the dedication of areas of outstanding significance as a forest sanctuary. The Act states that the Governor-General may proclaim a forest sanctuary in order to:

"...set apart any area or areas of State forest land as a forest sanctuary for the purpose of preserving in their natural state the indigenous flora and fauna therein for scientific and other like purposes." (s.20(1)).

The act of setting apart an area of State forest as a sanctuary is the highest dedication available for preservation purposes, and can be revoked by an Act of Parliament. To this extent it has equivalent statutory standing as a national park created under the National Parks Act 1980.

Ecological areas are set aside primarily for scientific purposes and the protection of natural ecosystems, but are not so unique in character as to be designated as forest sanctuaries (Appendix to Kirkland, 1975).

7.2 National Parks Act 1980

Protection for areas of New Zealand's indigenous forests is also given by the National Parks Act 1980. The Act's intent is:

"...preserving in perpetuity as national parks, for their intrinsic worth and for the benefit, use and enjoyment of the public, areas of New Zealand that contain scenery of such distinctive quality, ecological systems or natural features so beautiful, unique or scientifically important that their preservation is in the national interest..." (s.4(1)).

The Act continually stresses the preservation of indigenous flora and fauna as a primary consideration.
7.3 The Reserves Act 1977

The Reserves Act makes provision for the preservation and management of reserves throughout New Zealand:

"...ensuring as far as possible, the survival of all indigenous species of flora and fauna, both rare and commonplace, in their natural communities and habitats, and the preservation of representative samples of all classes of natural ecosystems..." (s.3(b)).

It is possible within the terms of this Act to designate a particular purpose for a reserve. Among these designations are:

(i) National Reserve (s.13)

(ii) Scenic Reserve (s.19)

(iii) Nature Reserve (s.20)

(iv) Scientific Reserve (s.21)

(i) National reserves are those areas set aside:

"...in order to protect values of national or international importance...on the recommendation of the Minister." (s.13(1))

Under the Reserves Act 1977, the classification of National Reserve is accorded a status equivalent to that of a forest sanctuary. Like a forest sanctuary and national park, the status and designation of a National Reserve area can only be revoked by an Act of Parliament. (s.13(2)).

(ii) Scenic reserves are those areas of land which are considered appropriate:

"...for the purpose of protecting and preserving in perpetuity...areas possessing such qualities of scenic
interest, beauty or natural features, or landscape that their protection and preservation are desirable in the public interest." (s.19(1)).

(iii) Nature reserves are areas set aside:

"...for the purpose of protecting and preserving in perpetuity indigenous flora or fauna or natural features of such rarity, scientific interest or importance or so unique that their protection and preservation are in the public interest." (s.20(1)).

Nature reserves are administered to maintain an area's natural values and, in common with forest sanctuaries and special areas within National Parks, entry into nature reserves is restricted unless under permit. The Act states that this is "for the better protection and preservation of the flora and fauna in its natural state" (s. 20(1c)).

(iv) Scientific reserves are those areas protected for the:

"...purpose of preserving in perpetuity for scientific study, research, education and benefit of the country, ecological associations, plant or animal communities...." (s.21(1)).

7.4 Land Act 1948

The Department of Lands and Survey is responsible under the Lands Act 1948 for administering the Land Settlement Board and farm development. The duties of the Board are stated as:

"...the administration, management, development, alienation, settlement, protection and care of Crown land..."(s.13(1))

Under the Land Act 1948, the Board, with the approval of the Minister: "may undertake and carry out such development works as it thinks fit" (s.44(1)).
This "development", particularly on the West Coast of the South Island, has involved the clearance of remnant patches of kahikatea and other indigenous tree species. This occurs on land being developed for farming purposes.

7.5 **The Queen Elizabeth the Second National Trust Act 1977**

The Act provides for the preservation of stands of indigenous forest throughout New Zealand which are typically remnant stands of native forest. The Act states such preservation is:

"...for the benefit and enjoyment of the present and future generations of the people of New Zealand..."

(s.20(1)).

Areas of forest may be granted protection by means of an open space covenant which requires that "the land to which it applies be maintained as open space" (s.22(4)). The interpretation of this Act defines open space as being:

"...any area of land or body of water that serves to preserve or facilitate the preservation of any landscape of aesthetic, cultural, recreation or social interest."

The covenant can have effect in perpetuity or for a specific term depending on the terms and conditions decided between the Trust and the owner.

There are six open space covenant areas administered by the Trust which contain kahikatea within their forest structure. These areas range in location from Te Kopuru near Dargaville in the north, to Waimahaka east of Invercargill in the south. (A.R. Thorpe, pers. comm.).

7.6 **Town and Country Planning Act 1977**

This legislation makes provision in the Second Schedule dealing with District Schemes for the preservation or conservation of:

"...trees, bush, plants, or landscape of scientific, wildlife, or historic interest, or visual appeal."

(s.36(5)(ii)).
This section has been applied to the Westland County Proposed District Scheme. The scheme (2.6.3.7) in part states the official position of the Westland County Council as being:

"Protection of regenerating podocarps, particularly rimu and kahikatea, and other isolated stands of scenic value".

The authors of the document comment that "this is a policy to preserve some of the existing character of Westland. While a worthy objective, Council recognises that it would be almost impossible to enforce."

On the Council's own admission, this policy is only a token gesture towards the preservation of the many pole stands of kahikatea in Westland, but it is a useful one. It represents an awareness of the species and perhaps some recognition of its demise. It is difficult to see why the Council concedes it cannot enforce part of its own plan, when it has very strong statutory powers to do so if it wished.
8.0 Policies Relating to Kahikatea

8.1 Management Policies of Government Departments

The remaining areas containing kahikatea swamp forest on Crown land are on land administered and managed by either the Department of Lands and Survey or the New Zealand Forest Service.

The objectives of these two land agencies are often quite different and have been listed in the "Preliminary Report on the Proposed Merger of the Department of Lands and Survey and the New Zealand Forest Service" (1982) as follows:

(i) Amongst the objectives of the Department of Lands and Survey is a stated need:

(a) To administer New Zealand's ten national parks, to preserve their integrity and unique natural features in the national interest;

(b) To identify areas meeting national park criteria;

(c) To identify the habitat and determine the appropriate protection and management of rare and endangered flora and the establishment of a representative protected area system for New Zealand;

(d) To administer, manage, develop, alienate, settle and plan on behalf of the Land Settlement Board the use of Crown land; and

(e) To acquire land for development, subdivision and settlement as farm units.

(ii) Some of the stated objectives of the New Zealand Forest Service include the "balanced use of all State forest land".
(a) To obtain the maximum long-term benefit to the community;

(b) To reserve outstanding and nationally important flora and fauna and to dedicate representative areas of all major indigenous ecosystems;

(c) To perpetuate specific State forests as managed stands; and

(d) To provide for and enhance recreational and educational opportunities.

8.1.1 New Zealand Forest Service Policies

The New Zealand Forest Service is responsible under the Forests Act 1949 for the exclusive control and management of the State's forests. Section 14(a) of the Forests Act describes in part the functions of the Forest Service as being:

"...the production of timber or other forest produce, the protection of land and vegetation, water and soil management, the protection of indigenous flora and fauna, and recreational, educational, historical, cultural, scenic, aesthetic, amenity and scientific purposes."

Since the 1960s when attention was focused by the environmental movement on a proposal to raise the level of Lake Manapouri, there has been a growing environmental awareness particularly with regard to lowland forests. This was highlighted by the Maruia Declaration in 1973 and by public criticism of the Forest Service indigenous forest management and policies. The criticism levelled at the Forest Service was strongly refuted in 1974 in an address to the Forestry Development Conference by the then Director-General of Forests, Mr Conway:

"...the department stands accused of presiding over the decimation of our remaining native forest, of irresponsibility, duplicity, hypocrisy and arrogance. Not one of these charges is accepted..."
In an attempt to meet criticism from the public and conservation groups, the Forest Service sought a new direction in policy. In a move away from the early attitude of "mining" of forests (Environmental Council, 1979), there was to be a clearly stated policy of sustainability for indigenous forests with forest management being directed to timber production in perpetuity. This policy was outlined at the Forestry Development Conference (1974-75). Adopted by the Government in 1975, it was published by the Forest Service in 1977, as the "Management Policy for New Zealand's Indigenous State Forests".

The introduction to the policy states the significant features of this policy to be:

"(i) It recognises that indigenous forests can fulfil a range of desirable purposes and that these need to be defined for specific areas.
(ii) Unless the need is adequately demonstrated, clearing of indigenous forest will not be practised.
(iii) It gives much emphasis to maintaining indigenous forest as such although modified in some cases, leaving options open for management decisions in accord with circumstances prevailing in the future."

(Management Policy for New Zealand's Indigenous State Forest, 1977)

The principal objective of this policy for indigenous forest management is stated as being:

"The object of management of State indigenous forest shall in general be to perpetuate indigenous forests both as natural forests and as managed stands."

The Management Policy for New Zealand's Indigenous State Forests (1977) recognises the conflicts in land use for land now occupied by indigenous forest and attempts to resolve these conflicts. As a result the policy contains six sections: a general policy; a production forest policy; a marketing and utilisation policy; a recreation policy; a protection forest policy and a policy for the reservation of forests for scientific purposes. Summaries of these sections are set out as follows:
Production Forest Sub-policy

1. Forests dominated largely by high-quality timber species may be harvested on the following basis, dependent on the condition of the forest:

(a) those with good regeneration potential:

(i) Sustained-yield Areas

All indigenous forests zoned for production which are dominated by species which yield high-quality finishing and decorative woods, are of sufficient extent to yield a continuous supply of such woods, and have a structure which facilitates regeneration by recognised silvicultural systems should be managed as indigenous forests for sustained-yield wood production, i.e., annually in perpetuity.

(ii) Periodic-yield Areas

Where indigenous forests of high-quality timber species with good regeneration potential are of insufficient extent for management as a sustained-yield unit the forest should be regenerated and managed to produce wood on a periodic basis in perpetuity as opposed to annually. The level of cut should continue to be governed by the aim of eking out dwindling supplies of finishing and special-purpose timber.

(b) those with poor regeneration potential:

(i) Partial-logging Areas

In indigenous forests zoned for production (whether previously partly logged or unlogged) but showing less promise of regenerating the dominant good-quality and veneer-producing species by
recognised silvicultural systems, and not occupying land that is needed for other productive purposes, a partial logging of merchantable trees should be practised with these objectives:

. To retain a forest structure similar in species diversity to the original forest and suitable for further logging if required.

. To achieve a certain degree of timber production.

. To leave land-use options open for subsequent resolution, e.g., indigenous forest management, exotic afforestation or farm development.

(ii) Conversion Areas

State indigenous forests should be clearfelled and converted to farm land or exotic forests only when other land in the region is either unavailable or unsuited for further development to meet the Government's social and economic goals, regionally or nationally.

2. Forests dominated largely by poorer-quality timber species:

(i) Regeneration Areas

In indigenous forests (whether previously logged or unlogged) which do not contain species yielding high-quality and decorative woods but which can be regenerated, and where the land is not required for any other productive purposes, logging should be conducted so as to ensure regeneration of a diverse indigenous forest.

(ii) Conversion Areas

As in 1(b)(ii)
Marketing and Utilisation Sub-policy

The Marketing and Utilisation Policy required the revision of procedures for marketing indigenous timber. It was recognised that the policy needed to be carefully introduced and implemented in order to avoid any sudden reduction or cessation of supplies to existing sawmills, with undesirable social consequences. The objective was to ensure that indigenous timbers would be milled, processed and marketed in a way that provided that their intrinsic qualities were put to best use. In general this means maximising the recovery of finishing and decorative grades or specialised products at the mill, together with logging practices which are economic, environmentally acceptable and compatible with management aims. (Forest Management Information, 1982).

Recreation Sub-policy

In broad terms current policy is stated to be:

To maintain large areas predominantly in their natural condition but with provision of tracks, bridges, and huts for public access and safety.

To recognise some areas as wildernesses, with no such provisions.

To safeguard sites and features of special scenic or historical value and to preserve biological associations of scientific interest including non-forested land.

To permit limited development of facilities for intensive public use close to forest boundaries.

To carry out such measures as are desirable and practicable to control wild animals and restore a vegetative cover on eroded land, using exotic species only where justified.
To utilise, for the production of exotic timber, scrub land within their boundaries that has no value for preservation.

To allow limited utilisation of merchantable indigenous forest with the aim of encouraging regeneration and management in perpetuity as indigenous forest.

**Protection Forest Sub-policy**

The main objective of this policy is the:

Protection of the forest and soil mantle to prevent the movement of debris into stream systems with consequent stream aggradation, flooding, and loss of water quality should be the first aim in all indigenous State forest areas.

**Sub-policy for the Reservation of Forest for Scientific Purposes**

State forest should continue to be reserved for scientific purposes, under the Forests Act 1949, in the form of forest sanctuaries, where preservation as near to its natural state as possible is a requirement. Areas to be used for scientific or educational purposes or protection of flora and fauna but which are not of such character or importance to justify recognition as forest sanctuaries, or are ineligible for that status, should be zoned and dedicated for those purposes under the Forests Amendment Act 1973.

For a fuller explanation of these sub-policies, the reader should refer to the source document.

Following public criticism of logging operations in the West Taupo podocarp forests which focused primarily on Pureora and concern about the proposed use of South Island beech forests, the Forest Service held public seminars at Taupo and Hokitika...
to discuss each particular region's future indigenous forest management. As a consequence of these seminars and public pressure, the Management Policy for New Zealand's Indigenous State Forests (1977) was supplemented in August 1978 by the Central North Island Indigenous Forest Policy which embraces not only the West Taupo forests, but Whirinaki and the West Coast Forest Policy.

Although largely a reiteration of the Management Policy for New Zealand's Indigenous State Forests (1977), these two policies included consideration of exotic afforestation where appropriate, particularly on the West Coast. The two additional policies are an attempt to reconcile many conflicting views on indigenous forest management whilst meeting a Government commitment to supply native timbers: "...after a study of the social environmental and economic factors has demonstrated that national and regional welfare would be enhanced..." (Management Policy for New Zealand's Indigenous State Forests 1977). The objectives of the policies may be found in Appendices 1 and 2.

Since 1975 total-wood sales from indigenous State forests have declined by 58 percent. This drop in production has been the result of rationalised management of forests, a reduction in the availability of the resource as a result of areas being set aside for reserves and a renegotiation of wood sales. With the introduction of selective logging techniques, the emphasis is now on the maintenance and regeneration of forests either naturally or by enrichment rather than wood production. (Forest Management Information, 1982).

8.1.2 Department of Lands and Survey Policy

The Department of Lands and Survey is charged under the Land Act with land development. On the West Coast "all land development operations are undertaken after full evaluation of forest remnants. In most instances today these remnants are left undisturbed and, where possible, fenced out from grazing areas. Areas of kahikatea considered to have important reserve values will generally not be settled in the conventional manner." (C.W. Thorpe, pers. comm.).

"The department does not at present have a specific policy on the conversion of land containing kahikatea stands (or indigenous forest) to pasture."
...the department does carefully evaluate the land resource before commencing development operations and wherever possible will exclude any areas identified as having special values which warrant protection."

(G. Young, pers. comm.)

The department "has been asked to advise the (National Parks and Reserves) Authority of its policy for the interim protection of these areas (remnants) and its policy on the protection of remnants on farm blocks. It is very likely that a formal policy statement will arise out of this" (G. Young, pers. comm.)

The current management attitude towards kahikatea appears to be ad hoc and designed to suit present circumstances rather than future objectives. Thus, it would be beneficial for the department to establish policy guidelines on land clearance, together with a clear management policy for land development blocks, so that the public can clearly and readily identify its stance on these issues.

8.2 Policies of Other Organisations

A number of environmental organisations have proposed differing but consistent policies for the preservation of New Zealand's lowland forests. Whilst only one specifically refers to kahikatea the others, like the Management Policy for New Zealand's Indigenous State Forests (1977), depending on the context and region, will include kahikatea. The recommended policies are a reflection of present societal values. Amongst them are:

8.2.1 Environmental Council (1979): The Council recommended "the protection of forests not in State tenure and therefore not covered by the Indigenous Forest Policy."

With reference to the South Island, it is suggested that, "where forests are judged to be of high international or national significance, regional interests must bow to national ones."

8.2.2 Royal Forest and Bird Protection Society of New Zealand (1980): This organisation maintains that "the primary focus in publicly-owned native
forest should be the reservation and protection in perpetuity of large areas of predominantly virgin forest..."

It is also advocated that there be a "safeguard that will delay logging of any privately owned forest until its conservation significance has been evaluated."

8.2.3 Native Forests Action Council (1977): In a submission to the Minister of Forests, this group stated their de facto policy as the recognition of:

"(a) the beleaguered conservation status of the surviving remnants of kahikatea forest;

(b) the importance of the South Westland stands;

(c) the distinctiveness and value of kahikatea as an ecological, aesthetic and wildlife resource;

(d) the lack of justification for continued logging of kahikatea forest."
9.0 Extent of Kahikatea Examined

The only major survey which has included kahikatea as a species has been the National Forest Survey conducted by the Forest Service in 1955. This survey scrutinised New Zealand's indigenous forests primarily for their merchantable timber production volume rather than ecological attributes:

"...the great bulk of all available timber, particularly softwood timber, is contained in lowland forests of comparatively restricted extent. For these forests detailed resource inventories were required..."

(Masters, Holloway and McKelvey, 1957)

Table 3 shows the softwood timber resource in 1955. Regrettably there are no other figures available for comparison.

However, in 1976 the Forest Service carried out a survey specifically directed at the occurrence and status of kahikatea throughout New Zealand. The survey was conducted on an informal basis, with the results depending on the definitions used by respondents. In analysing these results the Forest Service has cautioned, "this does not invalidate the general conclusions reached (but) it does mean the data must be interpreted cautiously."

This survey, published in Forest Management Information, Number 14, showed (Table 4) that 79 percent (72 229 hectares) of kahikatea occurs on State forest land, 7 percent (6092 hectares) in national parks and reserves and 14 percent (13 222 hectares) on private or other types of land tenure. This survey established that a
TABLE 3: Softwood Timber Resources at 1.4.55

000 m³

<table>
<thead>
<tr>
<th></th>
<th>Kauri</th>
<th>Rimu</th>
<th>Miro</th>
<th>Totara</th>
<th>Matai</th>
<th>Kahikatea Minor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Island</td>
<td>651</td>
<td>16329</td>
<td>2866</td>
<td>2207</td>
<td>4471</td>
<td>1217</td>
<td>255</td>
</tr>
<tr>
<td>South Island</td>
<td></td>
<td>232</td>
<td>255</td>
<td>3339</td>
<td>1019</td>
<td>4839</td>
<td>481</td>
</tr>
<tr>
<td>Total</td>
<td>651</td>
<td>248</td>
<td>584</td>
<td>6205</td>
<td>3226</td>
<td>5575</td>
<td>6056</td>
</tr>
</tbody>
</table>

Source: Forest Management Information 1980
### TABLE 4: Distribution of Forest with Kahikatea at 1.1.79

<table>
<thead>
<tr>
<th>Area (ha)</th>
<th>State forest (incl. SFP &amp; Parks &amp; Reserves)</th>
<th>National Reserves</th>
<th>Private and Other</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>1,693</td>
<td>8</td>
<td>30</td>
<td>1,731</td>
<td>1.9</td>
</tr>
<tr>
<td>Rotorua</td>
<td>11,806</td>
<td>2,036</td>
<td>55</td>
<td>13,897</td>
<td>15.3</td>
</tr>
<tr>
<td>Wellington</td>
<td>271</td>
<td>465</td>
<td></td>
<td>736</td>
<td>0.8</td>
</tr>
<tr>
<td>Nelson</td>
<td>1,494</td>
<td>817</td>
<td>2,257</td>
<td>4,568</td>
<td>5.0</td>
</tr>
<tr>
<td>Westland</td>
<td>56,347</td>
<td>1,821</td>
<td>10,880</td>
<td>64,046</td>
<td>75.8</td>
</tr>
<tr>
<td>Canterbury</td>
<td>25</td>
<td>258</td>
<td></td>
<td>283</td>
<td>0.3</td>
</tr>
<tr>
<td>Southland</td>
<td>593</td>
<td>687</td>
<td></td>
<td>1,280</td>
<td>0.9</td>
</tr>
<tr>
<td>Total (%)</td>
<td>72,229 (79%)</td>
<td>6,092 (7%)</td>
<td>13,222 (14%)</td>
<td>91,543 (100.0)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Forest Management Information 1980
total of 91,543 hectares of kahikatea exist throughout New Zealand, as shown by Table 5, Distribution of Forest with Kahikatea.

A breakdown of these figures by Forest Service conservancies indicates 75.8 percent of kahikatea is found in Westland, 15.2 percent in Rotorua and five percent in Nelson. Appendix 3 shows the distribution of kahikatea for each conservancy.

With the exception of Hope Arm on Lake Manapouri, no areas of dense kahikatea swamp forest may be found outside the South Westland forests of Mataketake, Ohinematea, Hunts Beach, Katangarua and Saltwater.

Williams (1983), however, states a more dismal outlook:

"Some swampland associations seem near extinction; a mere 7,800 ha is classified as swamp forest. The climax kahikatea swamp forest has almost disappeared from the North Island and is now mostly restricted to Westland in the south."

The figures on the total area of kahikatea are disputed, because there is no consensus as to the specific definitions of kahikatea forest, and hence there is confusion in the areas being measured. As pointed out earlier in this paper (3.1) there are basically two types of kahikatea forest

(i) the dense floating kahikatea forests; and

(ii) stands of kahikatea, found on alluvial flats with other podocarps.

The environmental movement believing that the total distribution should only take into account:

"Dense kahikatea forest (which) forms a tangled root platform which allows the forest to stand virtually afloat over several metres' depth of dark peaty ooze and muck."

(Salmon, 1980)
The environmental movement has therefore used Salmon's definition of kahikatea to support his (Salmon's) hypothesis, that "the total extent of the remaining dense stands is 4500 hectares, and of the medium and low density stands is 5350 hectares." (Salmon, 1980).

The Forest Service does not appear to have used such an arbitrary description as used by Salmon (1980), but appears to have included trees which occur as singletons as well as groups or pure stands of kahikatea.
Table 5, Kahikatea Forest Types in New Zealand, indicates the definitions used by the Forest Service and the associated area. "Scattered trees" are found on 39 700 hectares or 43 percent of the total area of 91 543 hectares. "Mature, Kahikatea dominant" forest is only 12 498 hectares or 13 percent, whilst 29 800 hectares or 33 percent contains "mature Kahikatea within mixed podocarp forest."

In considering the figure of 91 543 hectares as the total area of Kahikatea and "a broad picture of the extent of the resource" (Forest Management Information, No. 14, 1980), the Forest Service has not considered the long-term sustainability of the resource.

By corollary Salmon's (1980) figure of 9850 hectares:

"Devastation and renewal - a dramatic but natural part of the life cycle for Kahikatea forest on the flood-plain of a major river. Other types of Kahikatea forest renew themselves and their soils in a less eye-catching fashion."

But as noted early (3.2), Wardle (1974) suggests podocarps may not be able to maintain their position:

"...in the long term, rimu gradually replaces Kahikatea and matai as podsolisation and gleying lead to decreasing soil fertility."

If Wardle's (1974) hypothesis is correct, the validity of Salmon's "renewal" is questionable and may be construed as misleading, as it ignores possible ecological succession.
### TABLE 5: Kahikatea Forest Types in New Zealand

*Distribution by tenure*

<table>
<thead>
<tr>
<th>Forest type</th>
<th>State forest (including Parks &amp; Private Reserves) (ha)</th>
<th>National Parks &amp; Reserves (ha)</th>
<th>Other incl. Private (ha)</th>
<th>Total (ha)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Regeneration</td>
<td>1,924</td>
<td>11</td>
<td>4,323</td>
<td>6,258</td>
<td>7</td>
</tr>
<tr>
<td>2. Pole stands</td>
<td>1,268</td>
<td>210</td>
<td>1,752</td>
<td>3,230</td>
<td>4</td>
</tr>
<tr>
<td>3. Mature (kahikatea dominant)</td>
<td>6,936</td>
<td>2,594</td>
<td>2,968</td>
<td>12,498</td>
<td>13</td>
</tr>
<tr>
<td>4. Mature (within mixed podocarp)</td>
<td>24,955</td>
<td>2,626</td>
<td>2,234</td>
<td>29,815</td>
<td>33</td>
</tr>
<tr>
<td>5. Scattered trees</td>
<td>37,146</td>
<td>651</td>
<td>1,945</td>
<td>39,742</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>72,229</td>
<td>6,092</td>
<td>13,222</td>
<td>91,543</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Forest Management Information 1980
9.1 The Status and Extent of Kahikatea

In October 1982, the author wrote informally to all conservancy offices of the New Zealand Forest Service to determine the status, location, area and management of kahikatea. As no forest types for kahikatea were defined by the author, the replies indicate the respondents' individual interpretation. Accordingly, as with the Forest Service survey (1978), the data must be interpreted cautiously.

The replies to this request are summarised below:

Rotorua: "As a species it is well represented in a wide range of podocarp and podocarp/hardwood forest types... As 'pure' communities, it is uncommon; these total at least 50 hectares of stands less than five hectares known of, and closer to 100 hectares including stands down to 1 hectare in size. The status of many stands is described as 'uncertain of present extent, may be gone', or 'getting tatty... or tatty remnant from larger stand'". (J. Bathgate, pers. comm.)

Wellington: "The trees tend to occur as singletons rather than as groups or pure stands although some remnant stands have been noted. These areas are only minimal in both area and volume and would not constitute a viable resource." (D. Lowry, pers. comm.).

Westland: (i) North Westland. "This region contains 3390 hectares of kahikatea mostly in small scattered blocks less than 20 hectares... Virgin stands are practically non-existent in the northern region."

(ii) South Westland. "Both pure kahikatea stands and mixed kahikatea/other podocarp stands are included. A total of 10 450 hectares of such forest exist." (A. Reid, pers. comm.).

Canterbury: "Little kahikatea is found in Canterbury State forests, and in almost all occurrences, kahikatea is only present as scattered trees, often emergents." (E.R. Crozier, person. comm.).

Southland: "The bulk of what remains of white pine-dominant stands is in National Park or Scenic Reserve... otherwise white pine occurs sporadically, as individuals in lowland hill forest." (S. Swift, pers. comm.).
The responses indicate that as dense stands, kahikatea is almost non-existent, with the exception of South Westland. Kahikatea appears to be found primarily as regeneration or pole stands (11%) or scattered trees (43%) rather than kahikatea dominant forest (13%) (Table 5). On developed farmland pole stands and scattered mature trees seemingly owe their existence to the reluctance of the present land owners to mill them, although their future cannot be so certain.
In recent years a number of conservation organisations and individuals have expressed concern over the continued logging of kahikatea throughout New Zealand, and the future of the species. Despite this, logging is still occurring, not only in State forests but also private, Maori and Crown leasehold land.

Whatever the accuracy of the total area remaining of kahikatea-dominant forest, whether only 9850 hectares (Salmon, 1980) or 12 500 hectares (Forest Management Information, 1980), a review of its management, end use and conservation is necessary because of the limited extent of the resource. Although the present management of kahikatea only within State forests is dictated by the "Management Policy for New Zealand's Indigenous State Forests" (1977) and the West Coast Forest Policy (1978), the current status of kahikatea demands consideration of a specific Government policy for the species.

At present Forest Service policies exist for:

(i) the management of all State indigenous forests; and

(ii) the management of particular species in indigenous State forests.

It would be desirable that these Forest Service policies be extended to:

(i) the management of indigenous forests on lands of any tenure; and

(ii) the management of particular species in indigenous forests of any tenure.

A precedent and model for such policy exists with the promulgation in 1973 of the Kauri Management Policy which only applies to State forest.

The primary objective of management of kahikatea on land of all tenures must be to:
(i) preserve sustainable areas of kahikatea to ensure a perpetually viable forest; and

(ii) manage the resource by silvicultural techniques to ensure production in perpetuity to meet future markets.

Proposed Policy for Kahikatea on all Crown Land

The object of management shall be to perpetuate kahikatea as a species, both in natural stands (whether healthy or not), and as managed forests.

This is to be achieved by the following means:

(1) The setting aside of representative areas of mature and immature kahikatea swamp and alluvial soil association. These areas should cover a wide range of age classes through seedlings and poles to mature and over-mature stands. They must, wherever possible, be large enough to be maintained as ecological entities, and be adequately buffered.

(2) To reduce as quickly as possible the permissible annual cut to the lowest level consistent with economic, social and legal constraints on all land owned or leased by the Crown, and encourage such a goal on land owned by private interest by offering compensation for lost capital earnings and employment.

(3) To manage the remaining areas of kahikatea on State forest land for production in perpetuity. Management to be by:

(i) artificial or natural establishment; and

(ii) those silvicultural practices necessary to maintain the forest in perpetuity by sustained yield methods

(4) To acquire areas of kahikatea or areas of regeneration not already in Crown ownership.

(5) To institute programmes of artificial re-establishment on selected sites on all Crown land.
(6) To encourage the use of locally-grown exotic timber species as a substitute for kahikatea wherever possible.

(7) To prohibit the export of kahikatea in any form, whether sawn or manufactured, until sustained yield management is a viable proposition.
11.0 Conclusion

Today the milling of kahikatea continues despite the fact that:

(i) It is recognised that only very limited areas of dense kahikatea swamp forest remain in New Zealand and those only within South Westland State forests;

(ii) For bird species kahikatea is a valued food source and winter refuge;

(iii) There are suitable exotic timber substitutes available for most present uses of kahikatea; and

(iv) Attrition of kahikatea swamp forest due to past land and timber exploitation now highlights the need to identify and provide for the preservation and management of this specific type of kahikatea forest.

The cessation of logging operations on lands of all tenure is a short-term requirement to ensure the future of dense kahikatea forests, particularly in Westland. These last remaining stands are a fragment of those which once existed and which have disappeared. During the period of any reduction in logging the extent of the resource must be reassessed before further commitments are made.

The controversy and debate over the future of New Zealand's lowland indigenous forests has continued periodically since the 1913 Royal Commission on Forestry and, with respect to kahikatea will probably continue into the future due to the disputes over the extent of both types of kahikatea forest (dense swamp and kahikatea found on alluvial river flats).

The environmental movement has become more politically aware and the many successes they may claim have been won, not on scientific grounds, but in the political arena. The high profile of the movement has been achieved as a result of a deliberate policy of emphasising the emotional aspects which the electorate can recognise and relate to.

As Darling (1970) wrote:
"It is easier to argue practical reasons for preserving the forest than to try and explain the gut feeling many people have for doing so; but those feelings are profound and very real and must not be ignored. A deep and widely pervading tide of human thought wishes there to be wild places, even though many people will never visit them. There is satisfaction and comfort knowing that they exist."
ACKNOWLEDGEMENTS

I would like to thank the following for the help, advice and criticism that they have offered in writing this dissertation: J. Bathgate, H. Blake, B. Burns, E. Crozier, G. Daly, B. Geden, L. Lochheed, G. McSweeny, A. Reid, P. Robin, and K. Smith.

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Lastly, without the typing skills and ability of Mrs Margaret Highland to decipher my handwriting, the end result would not have been possible.

To everyone concerned, again a big thank you.
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Thorpe, C.W. (pers. comm.)


Young, G.W. (pers. comm.)
GLOSSARY OF ZOOLOGICAL NOMENCLATURE

_Anthornis melanura_ - bellbird

_Bowdleria punctata_ - fernbird

_Chalinolobus tuberculatus_ - long-tailed bat

_Cyanoramphus spp_ - parakeet

_Egretta alba_ - white heron

_Galaxias argenteus_ - giant kokopu

_Hemiphaga novaeseelandiae_ - New Zealand pigeon

_Neochauna apoda_ - brown mudfish

_Nestor meridionalis_ - kaka

_Porphyrio melanotus_ - pukeko

_Porzana pusilla_ - marsh crake

\_tabuensis\_ - spotless crake

_Prosthemadera novaeseelandiae_ - tui

_Rallus philippensis_ - banded rail
GLOSSARY OF BOTANICAL NOMENCLATURE

Agathis australis - kauri
Aristotelia serrata - wineberry
Astelia grandis
Blechnum capense - ground fern
Carex spp. - sedges species
Carpodetus serratus - putaputaweta
Coprosma propinqua
  rotundifolia
  equalida
Dacrydium bidwilli - bog pine
  coleosoi - silver pine
  cupressinum - rimu
Cortaderia richardii
Cotula squalida
Epilobium microphyllum
Festuca-arundinacea - tall fescue
Gahnia rigida - grass species
Gunnera dentata
Holcus lanatus - Yorkshire fog
Leptospermum scoparium - manuka
Nothofagus fusca - red beech
Pennantia corymbosa - kaikomako
Phormium tenax - flax
Phyllocladus alpinus - mountain toatoa
Picea spp - spruce species
Pinus laricio - Corsican pine
ponderosa - western yellow pine
radiata - radiata pine

Poa caespitosa

Podocarpus dacrydioides - kahikatea
   ferrugineus - miro
   spicatus - matai
   totara - totara
   var waihoensis - totara

Pseudotsuga menziesii - Douglas fir

Rubus fruticosus - blackberry
   parvus - lawyer

Raoulia hookeri
   tenuicaulis

Sophora microphylla - kowhai

Taxus baccata - yew

Tsuga spp - hemlock

Typha orientalis - raupo

Ulex europeus - gorse

Weinmannia racemosa - kamahi
APPENDIX 1

West Coast Forest Policy: Objectives

The major objectives of the West Coast Forest Policy are:

1. To perpetuate State indigenous forests both as natural forests and as managed stands.

2. To manage selected podocarp and beech production forests for sustained yield of wood and other compatible forest values.

3. To maintain sawmilling throughout the West Coast in the short term at a level which allows a steady supply of sawlogs either from podocarp, beech and/or exotic forests.

4. To manage existing exotic forests and add new areas in such a way as to maintain a steady sawlog supply to forest industries in the long term.

5. To have as the first aim in all State forests the protection of the forest and soil mantle to prevent the movement of debris into stream systems. To achieve such protection by suppression of uncontrolled fires, prevention of trespass by domestic animals and control of wild animals.

6. To encourage the use of State forests for recreation.

7. To reserve representative areas of forest and associated native animals and land forms for scientific, educational and cultural purposes.
APPENDIX 2

Central North Island Forest Policy: Objectives

1. The amount of native timber cut from native State forests will be reduced as rapidly as practicable to a level that can be sustained in perpetuity; that is, the removal of no more timber than is produced each year by the forests.

2. Logging will be withheld from sensitive wildlife habitats, at least until the likely effects have been studied, and for not less than three years.

3. Reserves will be set aside for scientific, wildlife, educational and recreational purposes. These will include large areas of virgin lowland forests throughout the Central North Island.

4. Certain areas of North Island native forests should be managed for continued low level production of native timbers.

5. All forms of Government price control on native timbers should be removed to allow prices to rise as the timber production falls.

6. The new forest management policy for Central North Island native forests will be reviewed within three years in the light of additional information on the forests and their wildlife and changing patterns of use of native timbers.
APPENDIX 3

CONSERVANCY: AUCKLAND

<table>
<thead>
<tr>
<th>Areas (ha)</th>
<th>State Forest</th>
<th>Reserves and Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>National Parks</td>
<td></td>
</tr>
<tr>
<td>Regeneration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pole Stands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (kahikatea (dominant)</td>
<td>8</td>
<td>30</td>
<td>38</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>1693 *</td>
<td></td>
<td>1693</td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td>1693</td>
<td></td>
<td>1731</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1693</td>
<td>8</td>
<td>30</td>
</tr>
</tbody>
</table>

* Total area of Waipapa Reserve

Notes: It is difficult to estimate total volume remaining since areas of dense kahikatea are negligible.

Kahikatea occurs as a scattered tree in mixed podocarp/hardwood areas.

Small clumps of regeneration are scattered throughout conservancy (mostly as freehold land).

Total kahikatea resource not in reserves is:

- Northland State Forests: 35 000 m³
- King Country: 20 000 m³
### CONSERVANCY: Rotorua

<table>
<thead>
<tr>
<th>Areas (ha)</th>
<th>State Forest (including SF reserves)</th>
<th>Reserves and National Parks</th>
<th>Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regeneration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pole Stands</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (kahikatea (dominant))</td>
<td>6</td>
<td>736</td>
<td>55</td>
<td>797</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>11 800</td>
<td>1300</td>
<td></td>
<td>13 100</td>
</tr>
<tr>
<td><strong>Scattered tree areas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>11 806</td>
<td>2036</td>
<td>55</td>
<td>13,897</td>
</tr>
</tbody>
</table>

**Notes:** Not all kahikatea in conservancy is included in the above table.

Kahikatea occurs throughout the conservancy in both pure and mixed podocarp stands. The pure stands are now largely in scenic reserves with some pockets on farmland.

State Forest 58 (Whirinaki) is the only area where substantial production of kahikatea occurs. It is used for sawlogs and peelers.

Milling also occurs on some Maori land.

Trial indigenous planting programmes commenced in 1977 to restock selectively logged areas with a total of 400 ha planned for planting by 1980, with a 45% stocking of kahikatea.
### CONSERVANCY: WELLINGTON

<table>
<thead>
<tr>
<th>Areas (ha)</th>
<th>State Forest (including SF reserves)</th>
<th>Reserves and National Parks</th>
<th>Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regeneration</td>
<td>10</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Pole Stands</td>
<td>5</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Mature (kahikatea dominant)</td>
<td>21</td>
<td>325</td>
<td></td>
<td>346</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>235</td>
<td>140</td>
<td></td>
<td>375</td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>271</strong></td>
<td><strong>365</strong></td>
<td></td>
<td><strong>736</strong></td>
</tr>
</tbody>
</table>

**Notes:** Kahikatea is found in nearly all areas of indigenous forest throughout the conservancy occurring mostly as single trees, although some remnant stands on private land were noted.

- **Wairarapa:** Occurs mostly on private land as single trees and stands less than 2 ha in area. Some mature forest in Tararua and Haurangi Ranges.
- **Bulls:** Some mature stands in scenic reserves; numerous patches on farmland; and small pocket areas and individual trees in State forests.
- **Hawkes Bay:** Occurs as minor forest species in remnant softwood forests; also occurs in some State forests and on farmland.
- **Tongariro:** Found in nearly all areas of indigenous forest.

**NB:** Considerable areas were not accounted for in the survey because of their small and scattered nature.
**CONSERVANCY : NELSON**

<table>
<thead>
<tr>
<th>Regeneration</th>
<th>State Forest (including SF reserves)</th>
<th>Reserves and National Parks</th>
<th>Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole Stands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (kahikatea (dominant))</td>
<td>103</td>
<td>26</td>
<td>127</td>
<td>256</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>1391</td>
<td>791</td>
<td>2130</td>
<td>4312</td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1494</td>
<td>817</td>
<td>2257</td>
<td>4568</td>
</tr>
</tbody>
</table>

Based on Park and Walls (1978) survey of the tall forest on lowland plains and terraces in Nelson and Marlborough Land Districts. Within these land districts a total of 21,681 ha of tall forest was surveyed, and of this 18,953 ha contained kahikatea. Only 4,568 ha was surveyed in Golden Bay, Waimea, Marlborough and Kaikora Counties which constitute Nelson Conservancy. Also included in the Nelson Conservancy is the part of Buller County north of the Little Wanganui River. The remaining 14,385 ha are in Buller and Inangahua Counties which are now part of Westland Conservancy.

Notes: The forest types of Park and Walls (1978) have been amalgamated on the basis of the surveys undertaken in other conservancies.
## CONSERVANCY: WESTLAND

<table>
<thead>
<tr>
<th>Areas (ha)</th>
<th>State Forest (including SF reserves)</th>
<th>Reserves and National Parks</th>
<th>Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regeneration</td>
<td>1014</td>
<td>11</td>
<td>4323</td>
<td>6248</td>
</tr>
<tr>
<td>Pole Stands</td>
<td>1263</td>
<td>210</td>
<td>1752</td>
<td>3225</td>
</tr>
<tr>
<td>Mature (kahikatea (dominant)</td>
<td>6331</td>
<td>929</td>
<td>2756</td>
<td>10 016</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>9693</td>
<td>20</td>
<td>104</td>
<td>9817</td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td>37 146</td>
<td>651</td>
<td>1945</td>
<td>39 742</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5647</strong></td>
<td><strong>1821</strong></td>
<td><strong>10 880</strong></td>
<td><strong>69 048</strong></td>
</tr>
</tbody>
</table>

### Notes:

**NORTH**
- Mostly pole stands less than 5 ha on freehold land
- Virgin stands almost non-existent
- Scattered trees on farmland and in scenic reserves

**SOUTH**
- Mostly mature stands of less than 20 ha with associated pole stands along margins
- Scattered trees on farmland

**Conservation**
- Stands in scenic reserves and national parks are assured of preservation (expect damage from animals or change of water course).
- Future of freehold stands less certain though some farmers interested in management. Retention of pole stands in forest and on farmland desirable for aesthetic, environmental, scientific and forest management purposes. Regeneration information can be obtained from these stands. A number of small trials are under way in south to replant logged areas with nursery-raised stock of kahikatea.
<table>
<thead>
<tr>
<th>Regeneration</th>
<th>Areas (ha)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pole Stands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (kahikatea</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(dominant)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (within mixed</td>
<td>258</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>podocarp forest)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
<td>258</td>
<td></td>
<td>283</td>
</tr>
</tbody>
</table>

Notes: There are only very small stands of kahikatea in Canterbury and these are mostly found in remnant areas too swampy to farm, or in reserves.

In State forests: Kahikatea is found in unlogged areas and is of indifferent quality.

Reserves and National Parks: These contain the most significant areas of kahikatea. Individual areas or the total areas are not available although small in total

Other tenure: Not surveyed in detail. The largest area is Mt Torlesse (privately owned). A pole stand exists near Oxford. The 258 ha recorded comprises two scenic reserves.

Crown leasehold - Scattered component in podocarp/hardwood forest.
### CONSERVANCY: SOUTHLAND

<table>
<thead>
<tr>
<th>Areas (ha)</th>
<th>State Forest</th>
<th>Reserves and Other Tenures</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(including SF reserves)</td>
<td>National Parks (Area and volume largely unquantified)</td>
<td></td>
</tr>
<tr>
<td><strong>Regeneration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pole Stands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature (kahikatea (dominant))</td>
<td>450</td>
<td>570</td>
<td>1020</td>
</tr>
<tr>
<td>Mature (within mixed podocarp forest)</td>
<td>143</td>
<td>117</td>
<td>260</td>
</tr>
<tr>
<td>Scattered tree areas</td>
<td></td>
<td>Sporadic</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>593</td>
<td>687</td>
<td>1280</td>
</tr>
</tbody>
</table>

Notes: In Southland kahikatea is generally a flood plain remnant on land now under intensive agriculture.

Virtually all kahikatea is found in western Southland and the best quality is in national parks and scenic reserves. A "magnificent" stand occurs at Hope Arm (Manapouri). Kahikatea also occurs sporadically in lowland hill forests but is less than 1% of sawlog volume.

State forest logging is limited to incidental production in beech management areas.

Freehold and Maori land - sporadic logging from farm clearing.

National parks - contain the most spectacular areas.