



NEW ZEALAND:
COUNTRY REPORT
TO THE FAO INTERNATIONAL
TECHNICAL CONFERENCE
ON PLANT GENETIC RESOURCES

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Note by FAO

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CHAPTER 1

Introduction

The format of this report generally follows that recommended in the “Introductory Guidelines for Country Reports” provided by the FAO International Conference and Programme for Plant Genetic Resources. Indigenous plant genetic resources and introduced plant genetic resources are discussed in separate chapters, Chapters 3 and 4 respectively. Each of these chapters describes:

- *in situ* and *ex situ* collections including their scope, location, funding, documentation, evaluation, characterisation, regeneration and provision of materials to breeders and other users;
- the uses which are presently made of those plants, important past uses (especially in the case of indigenous plants, most of which are used much less extensively now than they were in pre-European times) and potential future uses (again, particularly in the case of indigenous plants which are now being investigated for valuable properties);
- the principal threats to conservation of biological diversity and its sustainable use.

Note: all prices mentioned are in NZ dollars.



CHAPTER 2

New Zealand and Its Agricultural Sector

2.1 GEOGRAPHICAL AND POPULATION OUTLINE

New Zealand is situated in the south-west Pacific Ocean. It consists of two main islands, the North Island and the South Island, along with numerous smaller islands, with a total land area of 270,500 square kilometres.

New Zealand is over 1,600 km in length, and around 450 km wide at its widest part. The terrain of New Zealand is very mountainous, and only a quarter of the land area lies below 200 metres in elevation. The North Island (115,777 square km) and the South Island (151,215 square km) are separated by Cook Strait, which measures 20 km wide at the narrowest point. The smaller, Stewart Island (1,746 square km), lies offshore of the southern tip of the South Island.

New Zealand is a long, narrow, mountainous country, which is surrounded by a large expanse of ocean. The climate of New Zealand is affected by: its location in a latitude where westerly winds are prevalent; the oceanic environment; the mountain ranges and the resulting orographic effects. This can create 'rain-shadows' in the leeward localities, often to the eastern side of the ranges, playing a large role in localised weather patterns. The predominantly westerly weather systems is periodically interrupted with cooler, southerly weather systems and warmer, northerly weather systems.

The ranges affecting the westerly progress of the weather systems result in more marked east-west differences in weather patterns, than the north-south climatic differences. Many parts of the country are exposed to extreme wind and rain events, with associated wind damage to property; cold fronts especially can lead to heavy rain resulting in flooding. The warmest temperatures in New Zealand usually, but not always, occur to the east of the main dividing ranges, where droughts can occur.

The population of New Zealand in the last Census, held in 1996, was 3,660,364. Of this, 75% lived in the North Island. Recent trends show a greater increase in the number of people living in the North Island, compared to the rate of increase for the South Island. The proportion of the population residing in rural areas of New Zealand has declined gradually over the last 50 years, and now only 15% of the population reside in rural areas. Reflecting the increasing urbanisation of the New Zealand population, 85%



of the population live in urban areas, and 68% of the total population live in the major urban areas (centres with a population over 30,000 people).

About 29 percent of New Zealand is legally protected in a natural or near-natural state, but there are some significant gaps in representation. Conservation of indigenous plants is discussed in greater detail in Chapter 3.

The total area of New Zealand under agricultural and horticultural use (including exotic forestry plantings) is 17,335,531 hectares (at 30 June 1993). Of this, 13,946,136 hectares are under grassland, lucerne, tussock or danthonia, with 6,182,602 hectares in the North Island and 7,708,617 in the South Island. The area utilised for horticultural use is 94,607 hectares, with 68,123 hectares in the North Island and 26,462 hectares in the South Island. The area used for exotic forests is 1,395,758 hectares, with 1,022,907 hectares in the North Island and 372,738 hectares in the South Island. The concentration of horticultural land use and exotic forestry plantings is higher in the North Island than in the South Island, due to climate, soils and economic pressures.

The trend in New Zealand has been a decrease in average farm-size. The small farms (less than 40 hectares) made up 27% of all farms in 1972, and this value increased to 46% in 1992. Conversely, over the same period the number of mid-sized farms (40 to 200 hectares) decreased by 11% over the same period. The small farms are often termed “lifestyle blocks”, and are frequently owned by farmers who have decided to live in rural areas, but gain their income from another non-agricultural occupation. The level of agricultural activity undertaken on these lifestyle blocks is often low, as the income generated from the production is not the main source of economic earning for those residing within it. The breakdown of farm size figures in 1993 was: 13% under 5 hectares; 33% between 5 and 39 hectares; 45% between 40 and 399 hectares; 8% between 400 and 1,999 hectares; and 1% over 2,000 hectares.

2.2 NEW ZEALAND AGRICULTURE

Agriculture employs around 10% of the working population. The proportion of the New Zealand workforce employed on farms has declined from 9.8% in 1981 to 8.9% in 1995 and this trend is forecast to continue. Similarly, the proportion of the New Zealand workforce employed in the wider agricultural sector has declined from 19.0% in 1981, to 16.4% in 1995.



New Zealand's traditional reliance on agricultural exports has lessened from a high of 80-90% of exports by value in the mid-1960s, to about 50-60% at present. The value of New Zealand's total agricultural production fell by 3% in the year to 31 March 1995, to \$10.2 billion.

The agricultural and horticultural industries in New Zealand are almost totally reliant on plants and animals imported from other countries. The main exception to this is the presence of native grass species in unimproved and semi-improved pastures. The timber industry still harvests native trees, notably in the west and south of the South Island, but at a much diminished rate following passage of the Forests Amendment Act 1993.

2.2.1 Pastoral Farming

Around 55% of New Zealand farms include some sheep farming. This figure illustrates the continued importance of sheep farming in New Zealand agriculture, even though the national flock size has declined in recent years. New Zealand is the largest exporter of sheepmeat, contributing 43% of global exports. In the last 10 years the removal of subsidies and subsequent fall in returns from lamb and wool has resulted in a decline in sheep numbers from their highest levels of 70.2 million in 1982, to 47.1 million in 1995. Contribution to gross agricultural production by sheep and lamb has decreased, from 18.67% in the early 1970s, to around 10.57% at present. In 1995 New Zealand exported 350,000 tons of sheepmeat and 215,000 tons of wool.

The contribution from slaughtered cattle to gross agricultural production in New Zealand has changed little since the early 1970's. The 16% share that cattle contribute to gross agricultural production ensure that cattle are easily New Zealand's second largest agricultural export product. The national beef herd increased over the six years to 4.8 million head in 1995. The recent fall in market returns from beef sales is likely to lead to a reduction in the national herd size. Beef and veal exports were 318,000 tons in 1995.

Dairy products, as a proportion of New Zealand's gross agricultural production has increased from 22% in the early 1970's to close to 25% today. Of the total milk production, 5 per cent is used for town milk supply, with the remainder made into processed products, of which 85% are exported. Dairy produce accounts for 15% of New Zealand's merchandise exports. Only 5 per cent of global milk production is traded internationally, and New Zealand milk exports comprise 25% of this value.

New Zealand had 1.5 million head of farmed deer in June 1995, which represents over 40% of the world's farmed deer. Numbers have increased



slightly since 1993. The main market for New Zealand's deer exports is Europe, which accounts for 90% by volume and 81% by value of total exports. Of the total value of deer exports: venison accounts for 60%; antler velvet accounts for 35%; and hides/skins account for the remainder.

2.2.2 Horticulture/Viticulture

Horticulture accounts for 14% of New Zealand's total agricultural export earnings. The value of these exports was \$1.44 billion in the year to June 1995. Export earnings from horticultural produces are: 31% from kiwifruit; 26% from vegetables; 25% from apples; 14% from other fruit; and 4% from floriculture. Ornamentals other than cut flowers are not highly significant in terms of export earnings. However, they are very important locally for enjoyment and for gardening, which is one of the most popular forms of recreation. As such, the nursery and garden supplies industry, which is based on both exotic and indigenous ornamentals, contributes notably to GDP.

New Zealand accounts for 28% of total world kiwifruit exports. The total New Zealand kiwifruit production for 1995/1996 was 210,300 tons, worth \$NZ 244m. Production is decreasing as vines are removed from less economically viable orchards.

New Zealand contributes only 1 per cent of the world apple production, but 10 per cent of the world apple exports, as only 7 per cent of all apples produced globally are exported (excluding trade within the European Union [EU]). The EU is the largest market taking 61% of exports. New Zealand orchardists are beginning to replace older apple varieties (e.g. Granny Smith) with newer higher returning varieties, such as Braeburn.

Demand for New Zealand wine has exceeded supply in the last few years, as the volume produced decreased due to poor grape harvests since 1991. However, in 1995 the total wine crush rose to 74,500 tons and is expected to increase further due to increased plantings since 1993. Wine makes up 0.2 per cent of total New Zealand exports, with a value of around \$41 million. The United Kingdom is the largest export market, accounting for 61% of wine exports.

As demand increases and the marketing of produce improves, exports of horticultural products from New Zealand should increase.



2.2.3 Production Forestry

New Zealand's planted production forest area is expected to reach 1.62 million hectares during 1996. About 71,500 ha of new plantings, (net of removals) are forecast for 1996, with 68,000 ha per year forecast thereafter until the year 2000. Radiata pine makes up about 91% of the planted production forest resource. Other planted production forest species include Douglas fir and other introduced hardwoods and softwoods. The bulk of the planted production forest resource (90% of the total planted area) is currently grown in plantations greater than 100 hectares. Many of the remaining smaller plantations are combined with pastoral farming. In 1995, planted production forest removals totalled 17 million m³, and exports of forest products were valued at \$2,649m.

2.2.4 Seeds, Grains and Other Field Crops

Production of seeds and grains contributes only 3% to the overall value of New Zealand's gross agricultural production, and the proportion of the agricultural land area under arable use is even smaller. However, New Zealand is well suited to produce forage seeds for export. New Zealand is not self sufficient in cereal production, and currently imports about half of its grain requirements. The area planted under wheat in New Zealand is currently around 44,000 hectares, and production was 227,000 tons in 1994. The amount of area planted with barley in New Zealand is presently about 82,000 hectares, and 405,000 tons were produced in 1994. Other grain crops produced in New Zealand include maize (133,000 tons in 1994), and oats (56,000 tons in 1994). Increased pig, poultry, and feedlot production are expanding the demand for grains in New Zealand, and with increasing concentrations of these industries in Canterbury.

Peas, potatoes, onions, squash and other vegetable crops are grown for domestic and export markets. Pea production was 60,000 tons in 1994, mainly for processing.

Trends and concerns

- More farmers trying out new crops and adding value to their crops, so there is a demand for new and high quality plant varieties, particularly for horticultural crops.
- Decreasing returns from and investment in traditional farming enterprises, particularly pastoral farming. The area of sheep and beef pastoral land has



decreased over the last ten years, whereas the areas of dairying, forestry and most horticultural crops have increased.



CHAPTER 3

Indigenous Plant Genetic Resources

The indigenous vegetation of New Zealand has been defined for the purposes of this report as that vegetation which evolved to a large extent within this country, and hence existed here before the first human settlement.

3.1 GENERAL

New Zealand has an indigenous plant flora which contains a fairly small number of species relative to the land area by world standards, but has a high proportion of endemic species. The number of introduced vascular plant species is now greater than the number of indigenous species, and although many of these introduced species are not widespread or abundant, some are serious pests. There are 2,287 recognised indigenous species of vascular plants and 13,075 introduced. Of the introduced species, 2,421 are naturalised and the remainder in cultivation only.

About 10% of vascular plants have yet to be scientifically described, and a larger but less certain proportion of marine and freshwater plants. Fungi, including the lichens which are extremely well represented in New Zealand, are very poorly known and many remain to be described.

Several important features of this country's geological, ecological and human history have fundamentally shaped the plant genetic resources of New Zealand and the degree to which they have been, are, or may be used. These include the following:

1. Present day New Zealand was originally part of the great southern land mass, Gondwana. Over geological time, this land mass broke up into a number of smaller land areas. Of these, those which were most recently connected to New Zealand are Antarctica, South America, Australia, New Guinea, New Caledonia, Africa and India. New Zealand thus shares, to varying extents, a common biological lineage with these land masses.
2. New Zealand is 1,600 km from Australia, the nearest significant land area. This separation has constituted a barrier, although many natural plant introductions have been from Australia.



3. New Zealand was first permanently settled by Maori about 1,000 years ago, making it the last of the major land areas in the world to be permanently settled.
4. Prior to human settlement, most of the land area was covered in forest or scrub, with the remainder as grassland (mainly alpine) and wetlands.
5. There were no browsing mammals prior to those which humans brought, the only land mammals being two species of insectivorous and pollinivorous bats, along with marine mammals. The medium to large herbivore niches were filled by birds, many of which were flightless, and many of those birds are now extinct or critically endangered.
6. Most of the country experiences a moist, temperate climate.

As a consequence of such factors, New Zealand's indigenous plants:

- Display a high degree of endemism. At least 85% of the approximately 2,300 indigenous vascular flora species are endemic. There are also considerable numbers of endemic species among the approximately 1,100 indigenous species of mosses, liverworts and hornworts, 20,000 species of fungi and 4,000 species of algae (for example, 43% of seaweed species are endemic).
- Generally do not possess large, edible fruits (perhaps due to lack of large herbivorous mammals, which disperse plant seeds in many ecosystems).
- Generally do not possess large, edible storage organs such as tubers (perhaps due to absence of extreme dry or cold periods which might select for such structures).
- Where they have been domesticated for human use, the history of such domestication and any associated breeding is relatively short (compared to the thousands of years of domestication for some world crops).

Despite such caveats, Maori flourished on the indigenous land and sea resources, using many species and provenances of indigenous plant prior to European settlement, and many of these uses have continued into the present. These include uses of a wide range of timber species for construction and cultural purposes such as carving, several species of fibrous plants for making mats, clothing, bags, baskets and other woven goods, and food and medicinal use.

Timber production is the main direct use of native plants today. New Zealand forest species have provided a wide variety of specialist and general purpose timbers, but their use is now curtailed by legislation. Non-timber indigenous species make a relatively small contribution to the national economy at present, but some species have special cultural significance to Maori.



Indigenous plant species are valued by New Zealand society because of their uniqueness and the contribution they make to our landscapes. This value is clearly shared by many visitors, making a strong though intangible contribution to the tourism sector of the economy. The contribution of the indigenous flora to tourism is likely to be their major economic benefit for the foreseeable future. The discussion here will be restricted to the species of direct use to people, in the past or at present, or which have reasonable potential for future use. Terrestrial plants and marine algae (seaweeds) are covered separately, as the approaches to management and threats for each are distinct.

3.2 TERRESTRIAL PLANTS

3.2.1 Conservation Activities

Location, description and funding of collections

See Table 6, Annex 1, for summary information on conservation status.

Of the 2,287 indigenous terrestrial vascular plant species identified in New Zealand since European arrival, Cameron et al. (1995) listed 9 as “presumed extinct”, 20 as “critical”, 37 as “endangered”, 62 as “vulnerable”, and 79 as “rare”.

Indigenous species are mainly conserved through *in situ* conservation. Sites range from national parks and reserves and local government parks and reserves, through to sites of remnant vegetation on private land, often with no formal protection. New Zealand gives high priority to conserving all indigenous species, and particularly those under threat, as an important part of our heritage, and of world biological diversity. Some species have known economic value and the potential value of many others is being researched.

About 29% of New Zealand’s land area is legally protected in its natural state, but there are some significant gaps in representation. Decline is still occurring even in protected areas, e.g. due to pest species, but is most acute in lowland and coastal areas where there are few protected areas and land development has stressed and fragmented ecosystems. In all but a few districts, only tiny and barely sustainable remnants of coastal sand country and lowland wetland and alluvial environments survive (from Department of Conservation, 1994).

Living *ex situ* collections of some plant species and varieties are maintained at a variety of sites around the country.



These include:

- Botanical gardens in most major cities and some other localities, notably Auckland, Christchurch, Timaru and Dunedin, and the Otari Open Air Native Plant Museum in Wellington.
- Research collections (e.g. those of *Manaaki Whenua* - Landcare Research NZ Ltd (Landcare Research) at Lincoln and Havelock North and of the Universities).
- Several private arboreta (e.g. Hackfalls Arboretum near Gisborne and that of A. P. and H. Druce, Upper Hutt near Wellington).

Significant conservation is also achieved, albeit usually un-coordinated, through use of indigenous species in private gardens and in landscaping of business premises and public areas. Where cross-pollinating varieties are used in locations other than that of their original provenance, there is a risk of genetic contamination of the local stock. While some nurseries (notably the Taupo nursery, operated by the Department of Conservation [DOC]) and local authorities encourage use of local varieties, this is obviously impossible to ensure.

The flax (*Phormium* spp.) collection held by Landcare Research is one significant *ex situ* living collections. It was developed from the Rene Orchiston base collection of 50 cultivars. The cultivars were collected from around the country, and are propagated vegetatively because of high genetic variation in plants grown from seed. Flaxes have strong significance to Maori. They were traditionally used for making many woven items and for medicinal and spiritual uses. This collection, and its associated research programme, is an example of a focus on within-species variation in native plants. For the most part, conservation has been focused at the species level. Other examples of collections of species that show strong genetic variations according to geographical source, include the collections of *Ranunculus* by Fisher, *Parahebe* by Garnock Jones at Victoria University and manuka (*Leptospermum* spp.) *Korokia* spp. and kowhai (*Sophora* spp.) by Harris at Landcare Research.

There is little *ex situ* storage of indigenous plant seeds and vegetative material in gene banks. This is partly a reflection of the technical difficulty of storing seeds of some indigenous species and our lack of knowledge of species requirements such as dormancy mechanisms. Perhaps more important is unavailability of funding for what would be an expensive exercise and concentration of scarce resources on living collections. There will be some extra funding available from the Public Good Science Fund (PGSF), so research needs and priorities will need to be defined.



In addition to providing insurance against loss of living populations, the risk of genetic contamination of local provenances and non-local introductions may provide a rationale for *ex situ* germplasm storage of some species and varieties.

Documentation, evaluation, characterisation, regeneration and provision

Many herbaria around the country have extensive collections, and they and several universities have skilled staff able to identify and classify indigenous species and varieties. The largest are located at Christchurch (Landcare Research), Auckland (Auckland Institute and Museum) and Wellington (Museum of New Zealand *Te Papa Tongarewa*). Landcare Research holds a large collection of fungi and microorganisms at its Mount Albert station. There is some storage of seeds and other living matter (e.g. algal cultures) but conservation of living material is not the main purpose of these facilities.

Some collections are duplicated. For example there are duplicate collections of flax (*Phormium* spp.) held by Landcare Research and Victoria University/Wellington Botanic Gardens.

Landcare Research holds a computerised database of traditional uses of indigenous species, based at Havelock North. This resource is at present not easily accessible, but is being upgraded to run on modern software which should considerably increase its availability.

With regard to access to materials and information, this is not free in all cases, due to the outstanding issues relating to ownership (see next section). The flax (*Phormium* spp.) collection held by Landcare Research is available free to private and local government users for cultural purposes on request, but is not available for commercial purposes. As far as possible, where it is proposed that indigenous material should leave the country there is consultation with Maori. Availability of other materials which Landcare Research holds, such as ornamental manuka and cabbage tree varieties for ornamental purposes, is dealt with commercially. Landcare Research has Plant Varieties Rights (PVRs) on many of these plants and is developing a policy whereby revenue obtained from native plants in this way would be earmarked for investment in areas of research of concern to Maori.

The Nature Conservation Council developed a card file on threatened plants in cultivation. This documentation is useful, although has not been continued since the dissolution of the Nature Conservation Council in 1990.



3.2.2 Use, Evaluation and Improvement

Maori have a long history of use of indigenous plant resources (e.g. Harris and Heenan, 1992). Plants which Maori brought to New Zealand include kumara [*Ipomoea batatas*] and gourds (*Lagenaria* spp.), and others which did not survive and produce well in the cooler climate encountered here.

The issues of ownership and management of indigenous plants and consequent rights to use them are currently the subject of consultations between Government and Maori. These issues are described in section 5.3.

Maori developed uses for many indigenous plants, including the following:

Vulgar name	Latin name	Use
Harakeke (flax)	<i>Phormium tenax</i>	Fibre
Wharariki (flax)	<i>Phormium cookianum</i>	Fibre
Ti kouka (cabbage tree)	<i>Cordyline</i> spp.	Fibre, food
Kiekie	<i>Freycinetia baueriana</i>	Fibre
Pingao	<i>Desmoschoenus spiralis</i>	Fibre
Karaka	<i>Corynocarpus laevigatus</i>	Food
Aruhe, Raarahu (bracken fern)	<i>Pteridium esculentum</i>	Food
Kawakawa	<i>Macropiper excelsum</i>	Medicine
Pate (seven finger)	<i>Schefflera digitata</i>	Medicine (fungicide)

Various other species were used for food, medicinal, perfume and cultural purposes. The latter includes use for religious, decorative and perfumery purposes. Descriptions of many plants and their uses have been documented, for example by Cooper and Cambie, 1991, and Harris, 1988. Investigation of indigenous plants by Maori for useful properties continued after European settlement, particularly in the case of medicinal properties (Brooker et al, 1992).

Flax (*Phormium* spp.) was grown in several parts of New Zealand for commercial uses such as making woolpacks and floor coverings until the 1970s.

Species used for their timber in the past or at present include:

Vulgar name	Latin name
Rimu	<i>Dacrydium cupressinum</i>
Beech	<i>Nothofagus</i> spp.



Vulgar name	Latin name
Totara	<i>Podocarpus totara</i>
Kauri	<i>Agathis australis</i>
Kahikatea	<i>Dacrycarpus dacrydioides</i>
Tawa	<i>Beilschmiedia tawa</i>
Matai	<i>Prumnopitys taxifolia</i>

Rimu and beech are the main species which are used extensively at present. Legislation introduced in 1993 (the Forests Amendment Act), which applies to most but not all land, requires that stands of native forest are harvested at a sustainable rate (see Chapter 5 for more details).

A significant industry exists, based mainly on the West Coast of the South Island, harvesting sphagnum moss (*Sphagnum* spp.) for use as a potting material and in a recently developed range of sanitary pads. This latter use, along with use of the moss for bandaging wounds, was widely practised by Maori.

In recent times, evaluation of native plants for economic use has proceeded unevenly but a significant body of information has accumulated, building, in some cases, on the substantial knowledge developed by Maori. Two significant bursts of activity occurred during the two World Wars, with the aim of developing substitutes for certain imports, successfully in many cases. The economic significance of these uses is now generally small. However, present evaluation and improvement work is proceeding in several main areas, as follows.

Ethno botanical work is focused on plants of traditional importance to Maori, such as harakeke or flax (*Phormium* spp.), pingao and kiekie for weaving and other handcrafts, and kouka or cabbage tree (*Cordyline australis*) for fructose and fibre production. Landcare Research is undertaking much of this work, in association with Maori.

There is a long history of native plant use in **ornamental horticulture**. Some species are well established overseas in this use, such as *Hebe* spp., flaxes (*Phormium* spp.), *Cordyline* spp., kowhai (*Sophora microphylla*), manuka (*Leptospermum* spp.) and kanuka (*Kunzea* spp.). *Hebe* species were originally developed as ornamentals in New Zealand, but a large industry now exists in Europe. Other ornamental plants are being further developed by the New Zealand Institute for Crop and Food Research Ltd (Crop and Food Research) and Landcare Research, and by the nursery industry. Indigenous ornamentals make a large, although often overlooked, contribution to the New Zealand economy and landscape.



The New Zealand Forest Research Institute Ltd (NZFRI) undertakes some research into **timber** properties of indigenous species.

Research is continuing into deriving useful **extracts** from indigenous plants. Manuka, (*Leptospermum scoparium*) and kanuka, (*Kunzea* spp.) have long been known to yield essential oils. Crop and Food Research and Landcare Research are engaged in research on these species. Commercial operations near Gisborne at Te Araroa (a joint venture between a company and the Ngati Porou iwi) and at Coromandel, extract and market such oils. This research has revealed the existence of regional chemotypes of manuka and kanuka, highlighting the need for awareness of diversity within species.

Research into biologically active compounds in indigenous species is still very much at an early stage, but an industry existed until 1981 extracting steroid hormone precursors from poroporo (*Solanum laciniatum* and *S. aviculare*). The leaves of pate (*Schefflera digitata*, seven-finger), a small tree, contain a fungicide which was used by Maori for treatment of fungal diseases, and which may be commercially developed. A survey of indigenous plant extracts at New Zealand Institute for Industrial Research and Development Ltd (Industrial Research Ltd) showed that a large number of species contain biologically active compounds, particularly those causing cytotoxic and antibacterial effects (Bloor, 1995).

Crop and Food Research and the University of Otago have a co-operative research programme based in Dunedin, which surveys New Zealand plants for natural products that could be developed as new pharmaceuticals and agrochemical. Several promising extracts have so far been identified, including two insect antifeedant compounds from the leaves of horopito (*Pseudowintera colorata*). The economic value of insecticides and fungicides derived from natural plant materials is likely to increase as consumers become more concerned about the environmental and health impacts of conventional chemical sprays. They could also be important as pesticides for organic and minimum spray farming and growing systems.

At present, major non-timber uses of terrestrial native plants are for **forage, soil conservation, pulp and shelter belts**. Indigenous grasses are a component of many hill and high country pastures, being generally adapted to low fertility sites. Soil conservation on eroding land is often achieved by excluding livestock and allowing indigenous shrub and tree species to regenerate, sometimes assisted by plantings of indigenous species although more often by planting of exotics such as poplars and willows. New Zealand Pastoral Agriculture Research Institute Ltd (Ag. Research) staff are at present proposing a collection of indigenous grass species.



Non-vascular plants, fungi and micro-organisms

As noted earlier, New Zealand has vast resources of indigenous bryophytes, fungi and micro-organisms many of which have not yet been described, and their potential for commercial use is largely unknown.

3.3 MARINE AND FRESHWATER PLANTS

3.3.1 Marine Macroalgae

New Zealand has a marine macroalgal flora of approximately 1,000 species (classified within the Rhodophyta, Phaeophyta and Chlorophyta). The following list covers genera/species that either are or have been used in New Zealand or have attracted interest because of their potential use.

Seaweeds are used internationally in the following ways:

1. human food - sold either fresh in markets or as a dried or processed product;
2. animal food - in stock feed (e.g. cattle feed, poultry feed); as feed for aquacultured organisms (e.g. paua feed);
3. polysaccharides - alginates (from certain brown seaweeds), agar (certain red algae), carrageenans (certain red algae) - these are complex large molecules, that are unable to be synthesised, and are only found in particular seaweeds. The algal polysaccharides have very specific applications in a wide range of manufacturing processes, food processing;
4. medicinal properties - although there are various 'herbal' or traditional medicines based on seaweeds, these are not generally incorporated into western medicines because of their low potency. Recent exploration of algal extracts suggests there is potential for anti-viral, anti-AIDS and anti-cancer drugs to be isolated;
5. biomass - a number of countries have explored the use of rapidly growing algal material as a source of biomass to produce biofuels;
6. fertilisers - seaweed products are used as soil conditioners, and some seaweed based fertilisers have been developed.



3.3.2 Conservation Activities

Location, description and funding of collections

See Table 6, Annex 1, for summary information on conservation status.

The vast bulk of marine algae are conserved *in situ*, with very little material held *ex situ* (e.g. as laboratory cultures) except for the purpose of research on individual species. The locations of the various wild populations are described broadly in Table A.

Documentation and characterisation

Identification and description is mainly done by staff at The Museum of New Zealand, Wellington, and Otago University's Marine Biology Laboratory. The Cawthron Institute has a large collection of algae and undertakes work on introduced species and toxic algae. The National Institute of Water and Atmospheric Research Ltd (NIWA) undertakes marine taxonomy and has a large collection of marine algae. Auckland, Victoria and Canterbury Universities and Landcare Research are also involved in the taxonomy of marine species.

3.3.3 Use, Evaluation and Improvement

Table A (on the following page) describes the main existing uses of marine macroalgae.

Any evaluation for potential commercial uses is likely to be done by private firms, or by research institutes within New Zealand with funds from private firms. The major commercial operation in New Zealand, which has been involved in considerable evaluation work, is Coast Biologicals Ltd., Opotiki (Bay of Plenty).

Freshwater algae

Freshwater algal research, including identification and documentation takes place at the Universities of Canterbury and Waikato and at NIWA. A number of species are rare or threatened. Although freshwater algae perform an essential role in freshwater systems and provide an indicator of water quality, no individual species has yet been identified as having any other specific economic value.



Table A: Distribution and use of marine algae with existing or identified potential economic uses

Taxon	Distribution	Uses	Threats
<i>Pterocladia lucida</i> , <i>P. capillacea</i>	North Island, Northern South Island.	Source of agar; basis for New Zealand agar industry since 1941, wild harvest has been sustained for more than 40 years.	
<i>Porphyra</i> spp. - (Karengo)	6 spp. described in New Zealand, but likely to be 15-20. World-wide genus.	Genus used where ever it occurs world-wide; very high in protein (30% dry weight) and high in vitamins and minerals. Known as nori in Japan. Highly prized by Maori community and harvested throughout the country for local, non-commercial use; some commercial harvest.	Complex life history in which the conspicuous phase alternates with a microscopic phase that lives within shells and/or rock. There is the potential for local over-harvest if harvesters not aware of seasonal/yearly fluctuations in population size/ distribution.
<i>Gracilaria chilensis</i>	New Zealand and Chile.	Contains agar; used as fodder for paua.	Grows in harbours, estuaries, quiet coastal areas - alterations to habitat will influence local abundance (e.g. reclamation of coastal/estuarine land; building of marinas, coastal installations etc.; changes in sedimentation rates, nutrient regimes in estuarine or harbour areas).
<i>Curdiea</i> spp.	4 species endemic to New Zealand each with restricted distributions. Genus distributed in Australasia and Antarctica.	Sources of agar with very distinct properties.	Restricted distributions make these species potentially vulnerable to over-harvest unless managed with full knowledge of growth, reproduction, and recruitment rates.
<i>Gelidium</i> spp.	6 species endemic to New Zealand, some with restricted distribution. World-wide genus.	Contain agar.	Lack of knowledge about resource size and biology of species.
<i>Gigartina</i> spp.	More than 15 species in New Zealand. World-wide genus.	Contains carrageenan. The carrageenan properties are unique to particular species and phases within species.	Require knowledge about biology, growth, reproduction, recruitment before wild harvest or aquaculture can be undertaken.
<i>Durvillaea</i> - (Rimurapa) (<i>D. antarctica</i> , <i>D. willana</i> , <i>D. chathamensis</i> , undescribed species)	New Zealand and Southern Ocean.	<i>D. antarctica</i> used for poha titi (for storage of mutton birds in fat); contains alginates; harvested in Bass Strait.	Grows only on exposed shores; must be harvested during fertile period otherwise population does not recover from harvesting; considered to provide a buffering role in protecting coastal areas from wave erosion.
<i>Ecklonia radiata</i>	New Zealand, Australia, South Africa, Oman.	Contains alginate; used in production of sheep/animal health products by Coast Biological.	Important "tree" species in structuring sub-tidal forests therefore harvesting practices need to be careful to minimise habitat changes/impacts on other species.



Taxon	Distribution	Uses	Threats
<i>Macrocystis pyrifera</i>	California, Chile, Australia, New Zealand.	Species harvested extensively for more than 90 years from coast of California; contains alginates, also used for kelp powder/salt.	

Other species: within New Zealand we have species that are similar to or related to species used in other parts of the world but have not yet received commercial attention here, e.g. *Caulerpa* spp. (used extensively as a salad vegetable throughout Pacific and Asia); *Asparagopsis* spp. (highly prized by Hawaiian community).

3.4 THREATS TO CONSERVATION AND SUSTAINABLE USE OF INDIGENOUS PLANTS

Risks to *in situ* populations of indigenous plant species include effects of land development on habitats, including:

- direct modification of habitat, such as through land clearance;
- indirect effects such as siltation and changing water levels caused by forces acting outside the area concerned;
- attack by introduced animal and plant pest species.

Other threats include loss of "keystone species" such as kereru (wood pigeon) which disperse seeds of forest plants; effects of climate change, including effects on temperature, water cycle, sea level; and incidence of extreme events.

The threat from introduced pests is of great concern. Many native plants are highly palatable to introduced mammals, having few chemical or morphological defense mechanisms, as they have been subject to relatively mild browsing pressure during their evolutionary history. In addition, many species of introduced plants are strongly competitive with native plants. About 200 species have already been identified as serious weeds.

The harvest of products from indigenous plants is not always compatible with their conservation. Some species are conserved on offshore islands and harvest from wild plants is not permitted in forest parks and reserves, although permits can be obtained to collect small quantities for research purposes.

Most native plants are not legally protected except to the extent that they are located in formal reserves, in which case permission is required from the agency concerned (e.g. DOC or local authority) to remove the plant or parts of it. Although many individual trees and other plants are protected under local town planning regulations, this protection is of little value in terms of genetic protection. If the plant is on private land, the landowner's permission



is required. The only native plants which enjoy legal protection in themselves are new varieties which have been developed by breeding and are subject to Plant Variety Rights. A few plants are protected under the Trade in Endangered Species Act 1989. (In contrast, some native animals are protected by the Wildlife Act, including birds, most reptiles and some invertebrates, and fish species and marine mammals are protected by the Fisheries Act 1996 and the Marine Mammals Protection Act 1978 respectively).

New Zealand's indigenous grasses are not systematically conserved at present, although they are valuable for forage and soil conservation on less fertile sites. Native timber species are difficult to domesticate and hard to store as seed, so living populations need to be maintained.

Few of New Zealand's threatened native plant species are woody plants with timber potential. Nevertheless, within species variation of some woody species might be at risk despite there being considerable numbers of the species as a whole.

Threats to conservation of marine macroalgae include:

- threats from direct human actions, such as development in the coastal zone, pollution and potentially from overharvesting for some species. In addition to land-sourced pollution, anti-fouling coatings on vessels' hulls and marine structures such as wharf piles have contributed significantly to the destruction of marine organisms. The most toxic coatings based on organotin were banned some years ago. Marine plant species are not well protected by the existing marine reserves system;
- threats posed by introduction of exotic species, particularly via ballast water. New algae can compete with indigenous species, and pests and diseases can infest indigenous species. However, neither are likely to result in extinction of indigenous species.



CHAPTER 4

Exotic Plants

4.1 PASTORAL PLANTS FOR FORAGE AND SOIL CONSERVATION

This section covers grasses, herbs, shrubs and forage crops grown to provide animal feed and/or to stabilise soil, including turf grasses.

4.1.1 Conservation Activities

Location, description and funding of collections

Due to the importance of pastoral agriculture to the New Zealand economy, forage plants are New Zealand's single most important plant genetic resource in economic terms, and are likely to be so for the foreseeable future. New Zealand also grows considerable quantities of pasture and lawn herbage seeds mainly for export.

The national forage collection is held as seeds at the Margot Forde Centre, Ag. Research Grasslands Division, Palmerston North. This is identified as a regional centre for New Zealand and Australia for temperate forage species. The collection is associated with laboratory facilities for genetic and physiological research. Collections of *Rhizobium* bacteria associated with legume nitrogen fixation, and endophytic fungi of grasses are also held. Collecting expeditions to Europe and North and South America are undertaken periodically.

The Centre is recognised as having a collection of national importance by the national science funding system, and funding is relatively secure (see Annexes 2 and 3 for further details).

Private breeding firms have their own working collections, for which conservation is not a significant objective. Discontinued breeding lines are rarely maintained, and therefore usually lost, with consequent loss of genetic material.

New Zealand's large areas of permanent pasture effectively provide *in situ* conservation of locally adapted genotypes, from which collections are sometimes made.



Documentation, evaluation, characterisation, regeneration and provision

The main collection has computerised documentation, available on the World Wide Web. The collection is significantly larger than can be maintained by present regeneration practices, which are constrained by resources. Some erosion of accessions due to decline in viability seems inevitable.

There is free provision of base material to all researchers, and provision of improved breeding lines under contractual arrangements (see under "Use" below). Should a collection of indigenous grasses be established, its availability will take into account the views of Maori.

4.1.2 Use, Evaluation and Improvement

There is good co-operation between the genebank and private breeding firms.

Material is developed into new breeding lines by AgResearch staff, which are then commercially developed (including application for Plant Variety Rights if desired) by private breeding firms, under contractual arrangements including sharing in royalties.

International collaboration is generally very good, with free flow of accessions between the New Zealand and overseas gene banks.

4.1.3 Threats to Conservation and Sustainable Use of Forage and Soil Conservation Plants

Regeneration practices for the main forage genebank are not presently sufficient to maintain all seed accessions, so rationalisation is required. It is not known how much of the material stored in genebanks is still alive.

Access to genetic material from outside New Zealand is subject to domestic biosecurity (quarantine) legislation and policies.

Cultivars which were developed before the plant variety rights legislation cannot be granted proprietary rights and so royalties cannot be charged in order to fund the maintenance of those cultivars. Other funding sources have to be found for maintaining those cultivars.



4.2 FIELD CROP AND VEGETABLE CROP PLANTS

This section covers cereals, root crops and other vegetables.

4.2.1 Conservation Activities

Location, description and funding of collections

See Tables 1 and 2, Annex 1, for summary information on conservation status.

Responsibility for field crops and vegetable crops is largely that of Crop and Food Research. The Horticulture and Food Research Institute of New Zealand Ltd (Hort+Research) has minor involvement in a few species. Crop and Food Research is responsible for wheat, barley, oats, maize, peas, onions, potato and sweet potato (kumara), and other vegetables, along with other minor crops such as essential oilseeds. Hort+Research conserves and researches hops and tobacco, although the New Zealand tobacco industry recently ceased and with it the active research programme. There is no clear definition of the distinction between the plants which each institute is responsible for, and the CRIs are only funded to hold material used to carry out strategic research, which can lead to minor economic plants being conserved by neither.

The Crop and Food Research collection is housed at Lincoln, with some species in long-term storage at controlled temperature and humidity and others at ambient temperature and humidity. Foundation for Research, Science and Technology (FRST) has given the collection “Nationally Significant Database” status in accord with the Statement of Science Priorities.

The Hort+Research collection is housed at the Nelson Research Centre, Riwaka. It is funded by government as a part of Hort+Research’s “Collections of Significant National Importance”.

Documentation, evaluation, characterisation, regeneration and provision

Information relating to the Crop and Food Research collection is mostly computerised. Regeneration is systematic for arable crops, but varies for other species. Material is freely accessible to breeders.

The Hort+Research collections of hops and tobacco are presently maintained and documented, although the tobacco collection may be reviewed due to the



absence of an industry. Documentation on hops is not available outside Hort+Research. The principal commercial funders of research on products central to their industries tend to want to capture the benefits of such research. An example is the major breweries' reluctance to allow the results of hop research to be shared with their small non-contributing competitors.

4.2.2 Use, Evaluation and Improvement

There is good co-operation between the field crops genebank and private breeding firms, although the private breeding firms do not use the older landraces from the germplasm centre very frequently. This seems to be mainly because several crosses (i.e. several years) are needed to breed back to the yield and other characteristics of modern varieties, making the economics marginal in many cases. Lack of good base information on the characteristics of many accessions is probably another factor.

4.2.3 Threats to Conservation and Sustainable Use of Field Crop and Vegetable Plants

Responsibility for the various field crop and vegetable species is not always clearly allocated to one or other of the two main research institutes concerned.

The ability of national field crops genebanks to maintain and document accessions is uncertain, due to resource constraints. It is not known how much material is still alive.

Private breeding firms have their own working collections, for which conservation is not a significant objective. Discontinued breeding lines are rarely maintained, and therefore usually lost.

Plant breeding firms generally do not make extensive direct use of the national cereals collection

It is likely that many potentially valuable genes in old landraces will not be conserved because breeders and researchers are not using them at present.

4.3 HORTICULTURAL AND ORNAMENTAL PLANTS

This section covers fruit crops, nut crops, ornamentals and glasshouse horticulture species.



4.3.1 Conservation Activities

Location, description and funding of collections

See Table 4, Annex 1, for summary information on conservation status.

All our fruit plants have been introduced to New Zealand and it is most unlikely that any native plants will be used in the fruit industries. Our collections are therefore secondary collections although some, such as apples, are amongst the most important in the world. Ornamental collections contain plants from New Zealand and plants introduced from overseas. Many such individual collections are of world importance.

Hort+Research maintains the only comprehensive fruit germplasm collections in New Zealand. The collections are amongst the most useful in the world, and are funded by Government as Collections of Significant National Importance.

- The *Actinidia* (kiwifruit) collection is the best outside of China and is more comprehensive than any collections we know of within China.
- The collection of Asian peaches and nectarines is unique outside of Asia. The apricot collection is rich in genetically diverse material with cultivars from California, Canada, France, Greece, Italy, North Africa, Rumania and Russia.
- The Asian pear (nashi and yali) collection is particularly good.
- The pepino collection is unique.
- The hops collection is also unique because New Zealand is free of many pests and diseases found in other countries. New Zealand developed hops are valued too because they contain a higher proportion of the substance which makes beer bitter, and hence smaller quantities may be used to achieve the same result as imported hops.
- The berryfruit collection contains material necessary to support unique breeding programs.
- The apple collection is not only essential for on-going research but can also be considered as a part of New Zealand's heritage because so many cultivars were brought here by the first European settlers.
- The grape collection has about 650 varieties, and supports New Zealand's growing wine industry.



Many of the accessions are directly from the wild and are held as starting material for breeding and improvement programmes. In addition, reference collections of cultivars of many fruit plants are held.

The collections are the foundation for basic studies on fruit plants, for plant improvement and for the selection of improved cultivars. They are an essential research input for the programs undertaken by Hort+Research to extend further the range of crops that can be grown in New Zealand, to select new cultivars in anticipation of environmental or other changes and to make our existing fruitgrowing industries more competitive through the use of better cultivars. Thus the collections are not simply static museums and they do change according to need.

The fruit industry is reliant on its ability to maintain its market edge over competitor products through adding value. This is achieved by developing cultivars that differentiate New Zealand products, reduced production costs, enhanced productivity and quality and, to an increasing extent, production using integrated pest management systems. Sometimes processing adds value e.g. wine. New Zealand has an international reputation for developing successful new export crops. There are strong market requirements to differentiate fresh fruit cultivars, thereby adding value and quality to fruit improvement programmes. This is particularly true of the apple and kiwifruit industries, which together account for about two thirds of fruit export earnings. Genebanks provide the raw starting material for these programmes of plant improvement.

The collections are held on various Hort+Research research orchards with more valuable genotypes held at several sites.

It is likely that the fruit industry will continue to expand, despite its cyclic and volatile nature. The New Zealand industry is vulnerable to global economic events over which it has no control.

Government research funding for horticulture, arable and other food and beverage industries is to remain static and is directed at adding value. This means that it is becoming difficult to continue maintaining collections of the minor “novel” plants. For example, our collection of pepinos is unique but at present there are no active programs of research on pepinos. This results mainly from the Government’s “Statement of Science Priorities” for the Public Good Science Fund (1995), which stated as a strategic goal that “New Zealand must selectively support science in those areas of science which are of critical importance, and where research results can most readily be exploited.” Another goal emphasised that “The Government should fund cautiously in the case of ‘sunrise industries and diversification where there is not yet a private capacity to fund the research and where the private production, distribution, financing and marketing infrastructure required to exploit the research results



is limited, and encourage private contributions if, and when, the industry expands.”

Collections of nut crops are held primarily by private individuals. Their conservation is therefore not underwritten by any public agency at present, and relies on the commitment of those individuals involved.

There are no comprehensive collections of ornamentals in the country. New Zealand’s growing cut flower and ornamentals export industry is mainly dependant on exotic material. Some of these collections are at risk as the owners are elderly and there is a danger that collections may be lost or dispersed. The Royal New Zealand Institute of Horticulture (RNZIH) is keen to foster local networks and possibly a national network of plant collections of both ornamentals and native plants. The Herb Federation of New Zealand (Inc) also supports a semi-formal network of collections of herb species and varieties.

Most material has been imported by private individuals. It is now much more difficult to import material, mainly because of biosecurity requirements. This restricts the development of ornamentals which draw on a wide diversity of species. However, it should also be noted that past importations and botanic garden Index Seminums have contributed to the introduction of adventives to New Zealand. Some ornamental plants are now serious threats to New Zealand’s indigenous vegetation.

Research on ornamentals is variously done by Hort+Research, Crop and Food Research and Landcare Research (indigenous species), and in most cases the collections are working research collections only.

Documentation, evaluation, characterisation, regeneration and provision

Most fruit crops are held as long-lived perennial plants which take years to establish and are expensive to maintain in terms of labour costs and land. Collections must be continuously maintained and renewed. It is therefore encouraging that the collections have been recognised by FRST as being of national significance, so that continued funding is relatively secure. Most of the collections are curated by staff who are actually using the collections. It is our experience that maintenance long-term of such collections requires institutional support and that collections being used are those that are best maintained.

Computerisation of documentation is in progress for the main species. RNZIH has been preparing a checklist of specific collections, and Landcare Research holds an extensive database. The New Zealand Tree Crops



Association has a computerised database which lists the owner and location of 2,200 fruit and nut varieties. Most material is available although access to some material is limited because of the conditions under which it was imported, e.g., patented cultivars.

4.3.2 Use, Evaluation and Improvement

There are good links with similar collections overseas and frequent exchanges of fruit genetic material. Overseas scientists come to New Zealand to make use of the collections. Quarantine charges and the limited size of quarantine facilities means that it is more and more difficult to import new plants. Replacement of existing collections, should it be even possible, would cost millions of dollars in quarantine fees alone.

The primary use of the fruit genetic collections is for the development of new fruit cultivars but some collections are also used extensively for more basic studies.

4.3.3 Threats to Conservation and Sustainable Use of Horticultural and Ornamental Plants

Collections of minor crops are at risk. A national register of material, such as nuts and rare fruits, held outside the Hort+Research collections, should be considered.

Access to new genetic material can be hindered by quarantine costs and inadequate facilities.

A national register of ornamental collections is required . Only some of these collections are under institutional supervision.

Proper documentation and authentication of collections is very time consuming and hence expensive. This is probably the aspect that is currently most limited by resources.

4.4 TREES

This section covers trees grown for timber, crops, shelter, amenity and soil conservation.



4.4.1 Conservation Activities

Location, description and funding of collections

See Table 5, Annex 1, for summary information on conservation status.

The New Zealand Forest Research Institute, based in Rotorua, oversees the large majority of forest tree genetic resources. The Institute holds a number of living collections plus some seed and tissue-culture stocks in modern facilities. *Pinus radiata* is by far the most important species at present, with Douglas fir also important. Stocks of special purpose timber species and various minor species are also held, for market niches and as a contingency measure should grave biological problems (e.g. disease) beset *Pinus radiata*. The most important gene resource material, however, is in the form of living collections outside Rotorua. They are mainly in former State forests, which are now owned by various companies and the Forestry Corporation of New Zealand, which has just come up for sale. Such material is subject to covenant protection but it is still vulnerable to mishaps, and much of it currently attracts no commercial interest.

Hort+Research holds collections of trees for soil conservation, shelter and timber (poplars and willows) at Aokautere near Palmerston North and at Clyde in Otago. These are maintained as living collections (annually coppiced stoolbeds). Valuable material is also held in several private collections, including two arboreta near Gisborne (Eastwoodhill and Hackfalls), and some properties in the Manawatu. When New Zealand's poplar varieties were devastated by poplar rust which was self-introduced from Australia in 1973, Matsudana willow materials from the Eastwoodhill arboretum in particular were used to provide resistant materials for soil conservation and shelter.

In view of the widespread concern in New Zealand with ensuring sustainable land management, and the susceptibility to erosion of much of our hill country, having adequate genetic resources of soil conservation tree species is clearly of national significance. At present, the genetic base of poplars in New Zealand is narrow, and pure species of willows are only poorly represented. Suitable species for planting of riparian margins to help protect water quality, such as alders, also need to be more widely available.

Hort+Research also holds some collections of deciduous hardwoods (such as oaks), but the bulk of these genetic resources rest in botanical gardens (mostly managed by local government) and private properties.

Nut crop trees are discussed under the section on horticultural plants. As noted there, conservation is solely by private individuals.



Documentation, evaluation, characterisation, regeneration and provision

These are generally adequate for the major timber species and contingency species, except in some areas of regeneration. The more valuable or rare varieties of poplar and willow in the Hort+Research collection are vegetatively propagated. Because of cross-pollination, highly prevalent because most of the species concerned are wind-pollinated, it is very difficult to ensure pure seed stocks, and yet pure stocks of certain populations are needed.

4.4.2 Use, Evaluation and Improvement

Most materials are readily available for use. It is important that production forestry enterprises take account of impacts on indigenous ecosystems. The chief concern here is the protection of significant stands of indigenous vegetation within a proposed forestry development block, both when clearing existing vegetation to plant production forest and when harvesting (which may involve burning residues, and spraying herbicide prior to replanting). Signatories to the New Zealand Forest Accord, in 1991, include the New Zealand Forest Owners Association (which represents both New Zealand based and foreign owned forestry companies), environmental NGOs, and professional organisations such as the New Zealand Farm Forestry Association. By signing this Accord, signatories agreed to take account of valuable indigenous habitats. However, there is doubt by some of how well the Accord will work in practice, and some of the foreign-owned companies which have recently established in New Zealand are not signatories. The increased international value of plantation forests and greater overseas investment and technology has meant that clearing and replanting programmes tend to be undertaken on a more radical scale than previously. This tends to eliminate the stands of indigenous and non-radiata species which characterised forests managed by the former New Zealand Forest Service.

4.4.3 Threats to Conservation and Sustainable Use of Trees

Pinus radiata remains the main timber crop, but alternative species need to be kept available for utilization niches and contingencies.

Ownership of some valuable timber genetic resources has become dispersed since sale of Crown forest assets, and the value of this material is not always recognised or acknowledged by the new owners. A special problem is the perpetuation of certain genetic resources of *Pinus radiata* in the face of extreme pollen contamination pressures.



The recent arrival of pitch canker disease in California now imposes a major constraint on tapping key *in situ* conifer resources. The large areas of monoculture *Pinus radiata* are potentially susceptible to pests and disease.

Existing poplar and willow stocks are of relatively narrow genetic representation, and cross-pollination is also a problem. In view of the importance of such species for erosion control, a broader genetic pool would be desirable.

4.5 NATURALISED PLANTS (ADVENTIVES)

Weed species are not systematically conserved at present, but some may have scientific value for study, or potential for crossing with economic species and varieties. They can also be useful for conserving and improving soil and hosting predators of plant pests. Several naturalised plants are rare in their country of origin, for example *Lepidium hyssopifolium*.

4.6 GENERAL THREATS TO CONSERVATION AND SUSTAINABLE USE OF EXOTIC PLANTS

Regeneration practices for the main forage and field crops genebanks are not presently sufficient to maintain all accessions, so rationalisation is required. Those collections which are designated by FRST as being of significant national importance have relatively secure funding, although their status is periodically reviewed. One of the conditions of such funding is that there is access for scientific and other purposes by users, so this ensures their availability. However, at the time that such collections were identified (1993), the criteria applied were:

1. currently and primarily funded from the PGSF
2. irreplaceable
3. nationally and/or internationally unique
4. able to contribute to achievement of Government's agreed outcomes for science by supporting scientific research.

The first criterion thus excluded privately funded collections, regardless of their significance. One such collection is the Eastwoodhill Arboretum near



Gisborne, which is funded by a private trust and contains thousands of species and varieties of trees and shrubs, many of which are unique in New Zealand.

Concentration of funding on a narrow range of species that has immediate economic value leaves New Zealand vulnerable to future climate change and pest and disease outbreaks.

Access to genetic material from outside New Zealand is regulated by domestic biosecurity legislation and policies. There are two main pieces of legislation; the Biosecurity Act 1993 and the Hazardous Substances and New Organisms (HSNO) Act 1996. These are described in section 5.2.

The assessment procedures required for importations of either accessions of species already here (under the Biosecurity Act) or of new species (under the HSNO interim provisions), can involve costs and time to businesses. A consequence might be that this deters importation if the importer considers the cost and time involved outweighs any benefit gained from importing species. The quarantine requirements are imposed because New Zealand is relatively free of many pests and diseases of economic plants, and has a native biota which is highly vulnerable to introduction of aggressive competitors, browsers, disease, parasites and predators.



CHAPTER 5

National Goals, Policies and Programmes

5.1 NATIONAL PROGRAMMES AND POLICIES

New Zealand's policies for conservation of indigenous vegetation have also had the effect of conserving biodiversity to some extent. However, there has been more focus on conservation of species and ecosystems rather than the preservation and wise utilisation of genetic resources. The Government's broad policy on indigenous biodiversity, which requires preparation of a national strategy, is set out in Annex 4. The Department of Conservation and Ministry for the Environment are in the process of developing this national strategy, and expect to begin public consultation on it in mid-1997. There are a number of laws and policies that aim to conserve indigenous vegetation which are listed below. The Government's policy on sustainable land management also aims to promote the conservation of indigenous biodiversity, but does not address the question of biodiversity of agricultural and horticultural crops.

There is no co-ordinated national strategy for conservation and sustainable use of exotic biodiversity. However, the government does aim to preserve for New Zealand producers the ability to develop the new cultivars and techniques needed to enhance international competitiveness, advance environmental objectives and minimise costs. The PGSF system (see Annexes 2 and 3) provides security of funding for the main germplasm collections, generally at maintenance level only, where these collections are designated as "collections of significant national importance". More emphasis has been given to funding breeding programmes that yield an immediate economic return than to maintaining a broad genetic base. New Zealand is now largely dependant on the voluntary activities of private individuals and organisations to maintain collections of exotic plants, and on resources held by other countries.

The Ministry for Research, Science and Technology (MoRST) has commissioned a study on the appropriateness of establishing a National Science Strategy for biodiversity. The final report will address a range of issues including the scope of current biodiversity research in New Zealand, funding and coordination needs, international linkages and the elements of a possible future research strategy.



5.2 LEGISLATION AND PROGRAMMES TO CONSERVE NATURAL RESOURCES

The **Conservation Act 1987**, which established the Department of Conservation, the New Zealand Conservation Authority and Boards, and the New Zealand and Regional Fish and Game Councils, aims to promote the conservation of natural and historic resources. It defines conservation as the preservation and protection of natural and historic resources (which include plants and animals of all kinds as well as fungi, algae and bacteria) for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.

The **Reserves Act 1977**, provides for covenants to protect private land, wildlife, freshwater and marine life with natural, scientific, scenic or historic values, but depends upon the willingness of the landowner to have the land protected.

The **Wildlife Act 1953**, provides for wildlife sanctuaries, wildlife management reserves and wildlife refuges to be set up by Order in Council to protect wildlife and their habitat.

The **Native Plants Protection Act 1934** provides that it is an offence to remove protected native plants from any place.

The **Resource Management Act 1991**, which sets out the environmental management responsibilities of local authorities, aims to promote the sustainable management of natural and physical resources (which include all forms of plants and animals). Matters of national importance to be provided for in regional and district plans and policies include the protection of areas of significant indigenous vegetation, significant habitats of indigenous fauna, and wetlands. Resource management authorities are also required, among other things, to have particular regard to intrinsic values of ecosystems, any finite characteristics of natural and physical resources, and the protection of trout and salmon habitat.

Rules in regional policy statements and district plans have the status of law as do Heritage Protection Orders and Water Conservation Orders issued under the Resource Management Act. A range of funding mechanisms also exist to purchase land for conservation purposes or to pay landowners for reserving land through legally binding protection covenants.



The **Environment Act 1986**, which reformed the Commission for the Environment and established the Ministry for the Environment, aims to ensure that, in the management of natural and physical resources (which are defined to include, among other things, all forms of flora and fauna), full and balanced account is taken of, among other things, their sustainability, the intrinsic values of ecosystems (which are defined as systems of interacting organisms within their natural environment) and the needs of future generations. The Act also established the Parliamentary Commissioner for the Environment, which makes investigations, reports to Parliament, and advises public authorities on the allocation, use and preservation of natural and physical resources.

The 1993 amendment to the **Forests Act 1949** requires that the milling of indigenous timber from most privately owned indigenous forests in New Zealand be subject to a sustainable forest management regime that maintains the forest's ability to provide products and amenities in perpetuity while also retaining its natural values.

The **Fisheries Act 1996** aims to sustainably utilise fisheries resources while maintaining associated or dependent species, aquatic ecosystems and their genetic diversity. It replaced the much amended Fisheries Act 1983.

The **Biosecurity Act 1993** provides for the exclusion, eradication and effective management of pests and unwanted organisms. This includes quarantine matters, and aims to ensure that incoming goods, vessels and passengers do not carry significant risk of introducing a new disease or pest.

The **Hazardous Substances and New Organisms Act 1996**, sets up a new agency, the Environmental Risk Management Authority (ERMA), to assess hazardous substances and new organisms, including genetically modified organisms, for any adverse effects on the environment or human health and safety, before they are manufactured, developed, imported or released into the New Zealand environment, and to establish safeguards for their use. The Act was passed in 1996 but will not commence until late 1997.

At present, assessment of applications for releasing genetically modified organisms and techniques, for their effects on native biota, is carried out by two committees, the Interim Assessment Group for the Field Testing or Release of Genetically Modified Organisms (IAG) and the Advisory Committee on Novel Genetic Techniques (ACNGT).

The **Crown Pastoral Land Bill**, now before Parliament, will amend the tenure and management provisions of the Land Act 1948, enabling the sale of lease-hold tussock land in exchange for better protection of areas that still have some conservation value.



Beside these major laws, a range of more specific laws operate to promote conservation at the national and local levels. They include the Marine Reserves Act 1971; the Wild Animal Control Act 1977; the Queen Elizabeth the Second National Trust Act 1977; the Marine Mammal Protection Act 1978; the National Parks Act 1980; the Trade in Endangered Species Act 1989; and the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992.

Programmes for maintaining indigenous vegetation

About 77% (4.8 million hectares) of New Zealand's surviving indigenous forests are in **national parks** and **reserves** managed for ecological and recreational purposes by the Department of Conservation. A further 2% (about 130,000 hectares) have been voluntarily protected or committed for protection by private owners who have offered them for sale to the Department of Conservation or have attached legal covenants to the titles. The covenants may last from 20 years to perpetuity. These voluntary protection arrangements are funded by:

- the **Forest Heritage Fund**, which was established by the Government in 1990.
- **Nga Whenua Rahui**, which was established in 1990 for use by Maori forest landowners.
- The **Queen Elizabeth II National Trust**, which was established in 1997 with funding from both government and non-government sources. Landowners can enter a binding legal agreement with the Trust to protect all or part of their property. The agreement is usually in the form of a covenant which is registered on the property title.

Up to 10% (650,000 hectares) of the nation's indigenous forests may be subject to local authority rules governing forest clearance on erosion prone slopes. These rules are required under the Resource Management Act 1991 (see above) to sustain the life-supporting capacity of soil. Generally clearance is permitted subject to environmental safeguards.

The remaining 11% of indigenous forests are not in reserves or on erodible slopes but are subject to controls of one sort or another.

The **New Zealand Forest Accord** was signed in 1991 between forestry and timber industry representatives and environmental organisations. The signatories agreed that plantation forests would provide an alternative to the depletion of natural forests, and that the forestry industry would refrain from clearing native vegetation over "any area greater than five hectares, areas greater than one hectares which have an average canopy height of more than



six metres, and areas which have been or might be recommended for protection under the Protected Natural Areas Programme or as a Site of Special Wildlife Interest.”

Nature conservation in the **tussock lands** (areas of indigenous grassland) will be achieved through negotiation with individual lessees or owners. Protection mechanisms can include covenants or transfer of land to the department of Conservation. Areas in need of protection are being identified through surveys under the Department’s **Protected Natural Areas (PNA) Programme**. This programme, which began in the 1980s, aims to identify and protect representative areas of high biodiversity throughout the entire country.

5.3 OTHER RELEVANT LEGISLATION

The **Treaty of Waitangi Act** 1975 provides for claims from any Maori to be heard by the Waitangi Tribunal on any acts or omissions of the Crown since 1840 which are contrary to the principles of the Treaty of Waitangi. The Tribunal makes recommendations on the claims to the Crown. The recommendations are not binding on Government.

Discussions are taking place between Government and Maori over the ownership and management of plants indigenous to New Zealand, and the consequent rights to use those plants, their genetic material, or knowledge derived from them. This matter has been raised by indigenous peoples the world over, and is covered in Article 8(j) of the Convention on Biological Diversity.

In New Zealand, the matter is given a particular weight by its relevance to the Treaty of Waitangi. The Treaty, drafted by representatives of the Queen of England and signed in 1840 by both the Queen’s representatives and chiefs representing most Maori tribes, is generally considered to be the founding document of New Zealand as a nation. In exchange for ceding governance of the country to Queen Victoria, Maori were guaranteed, among other things:

“... the full, exclusive and undisturbed possession of their Lands and Estates, Forests, Fisheries and other properties which they may collectively or individually possess so long as it is their wish and desire to retain the same in their possession...”

In the Maori language version of the Treaty, signed by most of the chiefs, “full, exclusive and undisturbed possession” was translated as “*te tino*



rangatiratanga". Te tino rangatiratanga has a range of potential translations. Essentially, it denotes the power to not only possess what is yours, but to control and manage it in accordance with your own preferences. "Other properties" was represented as "*taonga*" in the Maori language version, which broadly translates as "treasures". Maori regard the preservation of the mauri (physical life force) of all living things an important responsibility.

A claim was lodged with the Waitangi Tribunal in 1991 by a group of Maori, essentially claiming that indigenous genetic resources are *taonga* which the Treaty did not assign to the Crown. This claim, known as Wai 262 (Waitangi Tribunal Claim No. 262), is presently scheduled to be heard in late 1996. In the meantime, it has created uncertainty over the ability of plant breeders and biotechnologists to develop and retain the rights to commercial uses for indigenous plants and how the government should react to applications for bioprospecting on New Zealand's conservation estate. Hence, little such research and development is occurring, although considerable development of some New Zealand plants, particularly ornamentals and some with valuable extracts, continues in other countries.

The Government recognises that for Maori the ownership of New Zealand's indigenous plants is an important issue. This issue is now being considered in the context of the Government's obligations under the Treaty of Waitangi and New Zealand's international obligations..

The **Crown Research Institutes Act 1992** set up the Crown Research Institutes.

The **FRST Act 1990** set up the Foundation for Research, Science and Technology which administers the Public Good Science Fund.

The responsibilities of these organisations are described in Annex 2.

The **Commodity Levies Act 1990** enables industry organisations representing a group of producers to impose a compulsory levy on a commodity by means of an Order in Council.

The funds collected through levies can be used for research. The Herbage Seeds Sub-section of Federated Farmers is proposing a levy on sales of non-proprietary cultivars of grass and clover species in order to pay AgResearch to maintain its breeding programme for these cultivars.



Intellectual property rights legislation

There are two elements of New Zealand's intellectual property rights system which are relevant in respect to plant genetic resources. These are plant variety rights (PVR) under the **Plant Variety Rights Act 1987**, and patents under the **Patents Act 1953**. These intellectual property rights are essential for the development of internationally competitive land-based industries in New Zealand. This is because:

1. Patents can protect new products or processes derived from genetic research on plants through the grant of a proprietary right that lasts for a period of 20 years.
2. PVRs can provide proprietary protection for new varieties of plants. Plant variety protection lasts for up to 20 years in the case of non-woody plants, or 23 years in the case of woody plants. PVRs are particularly important in plant genetic research because:
 - a. they provide incentives to breeders and, therefore, encourage investments and effort into plant breeding in New Zealand; and
 - b. they allow New Zealand access to overseas-bred varieties which would not be released here by their breeders without PVR protection.

The result of New Zealand's intellectual property rights protection, in terms of plant genetic resources, is that it encourages an increase in the number and range of varieties available in New Zealand.

PVRs in particular, are important economically for several groups. Some of these are:

1. Farmers growing arable and vegetable crops for commodity and seed purposes.
2. Those involved in research into new plant varieties.
3. Food-processing industries.
4. Home gardeners.



CHAPTER 6

International Co-operation

New Zealand generally experiences good international co-operation in plant genetic resources matters. There is mainly free flow of materials between overseas genebanks and New Zealand. Co-operation with Australia in temperate forage plants is particularly close. Expeditions to collect wild or cultivated material from overseas countries are occasionally mounted, particularly in the case of forage plants and fruit crop species. In all cases, permission of the host country is gained, and collecting is undertaken in close co-operation with appropriate organisations and persons from the host country.

New Zealand generally relies on multilateral agreements in dealing cooperatively with other countries

Plant genetic resources specialists in this country note that New Zealand benefits greatly from the resources of the Consultative Group International Agriculture Research (CGIAR) network, and consider it to be an important body, but we are not currently a financial member of this body.

New Zealand is a member of the FAO International Commission on Plant Genetic Resources, and is a signatory to the International Undertaking on Plant Genetic Resources. New Zealand is also a member of the International Convention on the Protection of New Varieties of Plants (UPOV).

As noted in section 5, the flow of genetic material out of New Zealand has slowed due to uncertainties over the ability of plant breeders and biotechnologists to develop and retain the rights to commercial uses of indigenous plants.

Trade, commercial and other international agreements

New Zealand's intellectual property rights system is consistent with the Trade Related Aspects of Intellectual Property Rights Agreement (TRIPS). The *sui generis* system for protection of plant varieties (required under Article 27(3)(b) of TRIPS) is provided for in the Plant Variety Rights Act 1987.

New Zealand's system of PVRs is also consistent with the 1978 UPOV Convention. It is envisaged that appropriate amendments will be made to the



Plant Variety Rights Act to enable New Zealand to ratify the 1991 changes to this Convention.

The New Zealand Government is also considering the issue of the access to and subsequent commercial development of New Zealand's indigenous genetic resources. This issue is a focus of the Convention on Biological Diversity and the United Nations Committee on Sustainable Development's recent project on Traditional Forest-Related Knowledge. The outcome of discussions in these fora will be of interest to New Zealand.



CHAPTER 7

National Needs and Opportunities

7.1 OPPORTUNITIES

New Zealand has great opportunities for the conservation of biological diversity, having the unique indigenous vegetation already described and a wide range of climatic and topographical habitats that can support plant life ranging from sub-Antarctic to sub-Tropical. New Zealand has the ideal climatic conditions and relative freedom from pests and diseases to become a repository for exotic taxa of conservation concern in its country of origin. This occurs to a limited extent already. For example the Tree Bank Trust is a group which aims to conserve in New Zealand species of trees at risk in their homeland, as well as addressing the conservation of New Zealand natives.

New Zealand has identified the following issues:

7.2 CONSERVATION OF VALUABLE MATERIAL TO NEW ZEALAND WHICH IS HELD IN OTHER COUNTRIES

- New Zealand's primary production is almost wholly dependant on exotic plants and animals, and is dependant on stocks held in other countries. Access to such stocks can be achieved partly by the CGIAR system.
- New Zealand generally relies on multilateral agreements. However, where New Zealand has concerns about access to varieties of a single species, bilateral understandings with the countries which are the primary centres for that species may be appropriate. New Zealand already has such understandings regarding exchange of genetic material with Argentina and Bolivia.
- Providing plant sciences training for nationals of developing countries in New Zealand universities and research institutes is one way that New Zealand can assist in conservation.



7.3 MORE EFFECTIVE CONSERVATION OF SOME SPECIES WITHIN NEW ZEALAND

- The development of a National Strategy on Biodiversity for indigenous plants is being given priority. A national strategy on biodiversity of exotic plants (i.e. economic plants) is also needed. Government is also investigating the need for a National Science Strategy for biodiversity, which, if established, would underpin the national strategy by identifying national priorities for biodiversity science and research.
- As funding resources are limited, it is likely that species of particular economic value will be given priority. Private individuals and societies who conserve “minor” species (e.g. enthusiasts in ornamentals, tree crops, herbs, etc.) achieve a great deal with minimal resources. Means of building on such efforts through better co-ordination and information flow need to be investigated.

7.4 BETTER FLOW OF INFORMATION AND PLANT MATERIALS WITHIN NEW ZEALAND AND INTERNATIONALLY

- Private plant breeders in New Zealand would make more use of some collections if the information on accessions (especially characterisation) was more detailed and easily available. This would be assisted by a national database or better coordination of existing databases. Carefully selected “core collections” which contain a representative range of the total variation in the main gene banks (forage and arable) could also be worthwhile.
- New Zealand genetic resource centres and plant breeders could make better use of overseas materials if information (especially characterisation) was more detailed and easily available. Although there are computer based systems available, time, funding and trained people are needed to prepare them for New Zealand.



7.5 BALANCING THE NEED FOR EFFECTIVE QUARANTINE PROTECTION WITH THE DESIRABILITY OF ALLOWING IMPORT OF NEW GENETIC RESOURCES WITHOUT UNDUE RESTRICTION

Standards are needed to enable some importation of genetic material at reasonable cost whilst still protecting New Zealand's biological resources from weeds, pests and diseases. The Ministry of Agriculture (MAF) will shortly be reviewing the requirements for importation of seeds for sowing, based on the comprehensive review of the status of plant species being carried out by Landcare Research.

7.6 INTERNAL AND INTERNATIONAL RESOLUTION OF INDIGENOUS GENETIC RESOURCES OWNERSHIP AND USE RIGHTS

Discussions are taking place between Maori and Government over Maori concern about the ownership and use of indigenous genetic resources. The main focus on this issue is the claim before the Waitangi Tribunal relating to indigenous flora and fauna, Maori traditional knowledge, cultural property and indigenous material (Wai 262). Once this claim is heard and the Tribunal has reported with its recommendations, the New Zealand Government will need to consider its response to the Tribunal's report. Among the issues likely to be considered in making policy decisions are expropriation or inappropriate use of this knowledge and property and mechanisms for their protection, taking account of already existing international obligations, such as the WTO TRIPS agreement.



CHAPTER 8

Proposals for a Global Plan of Action

- Strengthen the international plant genetic resources network (CGIAR).
- Develop more bilateral and multilateral joint ventures in research, training and management of plant genetic resources, including collection, storage, evaluation, documentation, and improvement.
- Countries need to develop quarantine legislation and procedures which effectively safeguard domestic biosecurity, without unduly hindering movement of genetic resources. The GATT SPS agreement should assist this aim.
- Countries need to develop clear guidelines for controlling export of indigenous plant species which are endangered at source.
- Encourage ratification of the Convention on Biological Diversity by all countries.



ANNEX 1

Summary of the Status of Plant Genetic Resources in New Zealand

(Tables 1-6 updated from Forde et al 1985, Table 7 adapted from table by Stephan R. P. Halloy, Journal of The Royal Society of New Zealand, Vol. 25, Number 1, March 1995.)

Table 1	Genetic Resources of Field Crops
Table 2	Genetic Resources of Vegetable Crops
Table 3	Genetic Resources Pasture and Soil Conservation Plants
Table 4	Genetic Resources of Fruit and Nut Species
Table 5	Genetic Resources of Forest Trees
Table 6	Indigenous Plants, other than Forest Trees
Table 7	Details of Genetic Resources in New Zealand



Table 1: Genetic resources of field crops

	Wheat	Barley	Oats	Maize	Tobacco	Hops
Seed storage	Long-term storage at 0° C and 35% RH (Crop and Food Research, Lincoln)	Long-term storage at 0° C and 35% RH (Crop and Food Research, Lincoln)	Long-term storage at 0° C and 35% RH (Crop and Food Research, Lincoln)	Long-term storage at 0° C and 35% RH (Crop and Food Research, Lincoln)	18°C sealed containers (Hort+Research, Riwaka)	N.A. (vegetatively propagated)
Regeneration	Systematic	Systematic	Systematic	Systematic	Systematic; collection grown in rotation to produce new selfed seed every 10 years	Living collections maintained at Riwaka Research Centre (Hort+Research)
Representation	3,500 wild collections and cultivars	1,500 cultivars and breeding lines, mainly of overseas origin	400 wild collections, cultivars and breeding lines	200 cultivars and breeding lines; mostly of N.Z. origin	300 overseas cultivars and 300 breeding lines, mostly of N.Z. origin	80 overseas cultivars and 350 breeding lines of N.Z. origin
Value and uniqueness	Important for local use; perhaps 75% unique (old land-races lost overseas)	Small international value; approx. 20% unique	Local value; some old N.Z. land-races may be unique	Local value only	Local verticillium wilt-resistant cultivars and breeding lines are unique	Significant value, triploid types unique, resistant to black rootrot. Tetraploid breeding material unique
Use	Working collection	Working collection	Working collection	Working collection	Tobacco industry now defunct	Primarily a working collection for breeding programme
Documentation	Full computer documentation of passport, characterisation and some evaluation characteristics	Full computer documentation of passport, characterisation and some evaluation characteristics	Full computer documentation of passport, characterisation and some evaluation characteristics	Full computer documentation of passport, characterisation and some evaluation characteristics	Computerised	Not available outside Hort. Research
Availability to other users	Available to any organisation upon reasonable request	Available	Available	Only material from U.S. universities	Freely available overseas and to N.Z. universities and CRIs	Some used commercially



Table 2: Genetic resources of vegetable crops

	Potatoes	Peas	Pumpkins/Squash (Cucurbita spp.)	Onions	Sweet potatoes (Kumara)
Living collections	Crop and Food Research, Lincoln	Crop and Food Research, Lincoln	-	-	Crop and Food Research, Lincoln
Seed storage	-	Room temperature low humidity (Crop and Food Research Lincoln)	10°C, 50% R.H. (Crop and Food Research, Pukekohe)	10°C, 50% R.H. (Crop and Food Research, Pukekohe)	In vitro; live plants
Representation	400 wild collections cultivars and breeding lines; N.Z. and overseas	450 wild collections cultivars and breeding lines	50 wild collections, cultivars, NZ and overseas	200 N.Z. and overseas cultivars and breeding material	9 lines - total existing representation of Maori varieties (pre-European)
Regeneration	Small number (20 tubers) replanted each year	On demand	On demand, lines isolated during increase	On demand; lines isolated during increase	Continuous
Value and uniqueness	Mainly local value; 10% unique	Local value only; none unique	Local value, breeding lines unique	Local value; breeding lines unique	Unique
Use	Working collection; all imported clones maintained	Working collection; conservation incidental	Working collection	Working collection; conservation incidental	Conservation
Documentation	Systematic, computerised	Not yet computerised; systematic descriptors planned	Systematic descriptors planned	Systematic descriptors planned	None
Availability	Available	Available	Available	Available	Available
Location of chief world genetic resources	Peru; Scotland, U.S.A.	U.S.A., India	U.S.A.	U.S.A., U.K., Holland	Japan, U.S.A.
Adequacy of conservation in N.Z.	As collection grows, staff and land for regeneration could be a problem	Adequate	Adequate - just commenced	Adequate	Adequate



Table 3: Genetic resources of pasture and soil conservation plants

	Forage & turf grasses, forage legumes and other grassland plants	Poplars & willows	Soil conservation Shrubs and herbs																								
Living collections	Extensive areas of permanent pasture, waste ground, sports turf etc.	HortResearch, Palmerston North (Aokautere); Clyde; Eastwoodhill Arboretum, Ngatapa, Gisborne; Hackfalls Arboretum, Tiniroto; Cousins pty, Colyton, Palmerston North; McKellar pty, Hunterville	Some scattered in past soil conservation species trial sites																								
Seed storage	Controlled long-term storage at 0°C and 25% R.H., Ag Research Grasslands Division, Palmerston North	-	AgResearch Grasslands, Palmerston North, at 0°C and 25% RH, and Alexandra at room temp																								
Representation	<table> <tr><td>Ryegrasses (<i>Lolium</i> spp)</td><td>17,000</td></tr> <tr><td>Fescues (<i>Festuca</i> spp)</td><td>5,200</td></tr> <tr><td>Cocksfoot (<i>Dactylis</i> spp)</td><td>2,800</td></tr> <tr><td>Bromes (<i>Bromus</i> spp)</td><td>1,500</td></tr> <tr><td>Other grasses</td><td>8,800</td></tr> <tr><td>White clover (<i>Trifolium repens</i>)</td><td>17,000</td></tr> <tr><td>Red clover (<i>Trifolium pratense</i>)</td><td>3,600</td></tr> <tr><td>Lucerne (<i>Medicago sativa</i>)</td><td>2,700</td></tr> <tr><td>Lotus spp</td><td>3,800</td></tr> <tr><td>Other legumes</td><td>7,600</td></tr> <tr><td>Other grassland plants (includes soil conservation plants)</td><td><u>1,100</u></td></tr> <tr><td></td><td><u>71,100</u></td></tr> </table>	Ryegrasses (<i>Lolium</i> spp)	17,000	Fescues (<i>Festuca</i> spp)	5,200	Cocksfoot (<i>Dactylis</i> spp)	2,800	Bromes (<i>Bromus</i> spp)	1,500	Other grasses	8,800	White clover (<i>Trifolium repens</i>)	17,000	Red clover (<i>Trifolium pratense</i>)	3,600	Lucerne (<i>Medicago sativa</i>)	2,700	Lotus spp	3,800	Other legumes	7,600	Other grassland plants (includes soil conservation plants)	<u>1,100</u>		<u>71,100</u>	National Collection: Annually-coppiced stoolbeds at Aokautere Poplar: 178 clones of 9 species and 4 hybrids. Willow: 207 clones of 40 species and 14 hybrids. Over 500 additional poplar and willow clones (principally hybrids) held in arboreta and trials	80-100 miscellaneous herbaceous and shrubby species
Ryegrasses (<i>Lolium</i> spp)	17,000																										
Fescues (<i>Festuca</i> spp)	5,200																										
Cocksfoot (<i>Dactylis</i> spp)	2,800																										
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Other legumes	7,600																										
Other grassland plants (includes soil conservation plants)	<u>1,100</u>																										
	<u>71,100</u>																										
Regeneration	Systematic but limited by resources to 150 entries per year	Vegetative propagation of 'valuable' or rare phenotypes	Selective; isolation provided as far as physically possible																								
Value and uniqueness	Significant as a world collection, although relatively little unique except breeding lines & N.Z. collections	Significant for NZ, Australia, Argentina, Chile and South Africa. NZ-bred hybrids of use to temperate zones of China	Local importance; not unique																								
Use	Primarily a working collection, conservation secondary to breeding objectives but significant	Primarily for breeding and selection of improved clones for soil conservation, windbreaks, agroforestry. Selection focused on disease and possum resistance and wood quality	Primarily for selection																								
Documentation	Computerised and available on WWW (World Wide Web); no systematic descriptors	Being computerised for national stoolbed collection at Aokautere, and will be extended by June 1996 to all sites mentioned above	Accession lists circulated; no systematic descriptors; computerisation beginning																								
Availability	Available if quantity permits, except for breeding lines and new selections	Clonal material available from Hort Research under non-propagation or trial site agreement. Royalty payment for released cultivars, unimproved selections and older hybrids at cost	Available																								



	Forage & turf grasses, forage legumes and other grassland plants	Poplars & willows	Soil conservation Shrubs and herbs
Location of chief world genetic resources	Europe, North and South America	Northern hemisphere (20-70N), particularly China, Himalayas and USA/Canada	Europe, USA, Australia
Adequacy of Conservation in NZ	Facilities excellent; documentation needs to be increased; more NZ collections sought; more overseas collections desirable	Gene pool collections now being documented, but pure species poorly represented for most willows. Narrow poplar representation	Better physical isolation needed during regeneration. Given increasing emphasis on sustainable land management, collection may not be adequate



Table 4: Genetic resources of fruit and nut species (part I)

	Apples, asian pears and pears	Stone fruit (apricots, cherries, nectarines, peaches, plums)	Fruit <i>Actinidia</i> and other
Living collections	Havelock North Research Centre, (Hort+Research) with some replicates at other orchards	Havelock North Research Centre, (Hort+Research) with some replicates at other orchards	Te Puke Research Centre, Nelson Research Centre, Kumeu Research Orchard, (Hort+Research)
Representation	650 accessions wild species, cultivars, sports, many thousands of genotypes in breeding populations	300 accessions wild species, cultivars, sports, also breeding populations	250 accessions, often with many genotypes per accessions. Wild species, cultivars, sports, also breeding populations.
Value and uniqueness	Apples one of the best collections in the world. Asian pears one of the best collections outside of Asia	Some material very rare	Probably the most comprehensive collection in the world. Much of the collections is irreplaceable.
Use	Breeding, conservation, experimental studies	Breeding, conservation	Conservation, breeding, experimental studies
Documentation	Computerisation underway	Computerisation underway	Computerisation underway
Availability	Readily available except for protected cultivars	Mostly available except for protected cultivars	Available except for protected cultivars or material imported with restrictions
Location of chief world genetic resources	U.K., France, U.S.A., Japan, Italy	USA, China, Europe, Commonwealth of Independent States, Rumania, Iran, Canada	China, Japan, Europe, USA, Russia
Adequacy of conservation in New Zealand	Adequate, but repropagation of may older plants required and replication for spreading of risk. More effort required on characterisation	Adequate, some replication required	Adequate but some replication required. More effort required on characterisation

Table 4: Genetic resources of fruit and nut species (part II)

	Grapes	Berry fruit	Sub-tropicals	Temperate nut trees
Living collections	Te Kauwhata being shifted to Havelock North Research Centre, (Hort+Research) with about half the collection replicated in other industry collections	Nelson Research Centre, Mt Albert Research Centre, (Hort+Research)	Various orchards, (Hort+Research) Mainly private collections of banana, passionfruit, loquat, casimiroa, guava, babaco/pawpaw	Private Individuals (Branches of Tree Crops Association)
Representation	650 accessions of cultivars, clones, rootstocks, selections	600 accessions wild species, cultivars, sports, breeding populations	Mainly overseas cultivars or wild genotypes: Citrus 160 accessions, feijoa 170, avocado 65, cherimoya 45, fig 34, Cythomandra 50, pepinos 80, olive 24, persimmons 40	40 N.Z. & overseas collections and cultivars include 40 pecan, 14 almond, 30 hazel, 30 chestnut, 50 walnut, 20 Geruina avellana, 40 macadania named varieties and local improved selections
Value and uniqueness	Replaceable only at great cost and with considerable difficulty. Very little unique. Virus status often uncertain	Strawberry collection has unique local cultivars, the Rubs collection is particularly valuable with half being irreplaceable	Mostly of local significance only; little unique (except for pepino which are largely irreplaceable)	Locally selected seedlings have been commended



	Grapes	Berry fruit	Sub-tropicals	Temperate nut trees
Use	Conservation, experimental studies, source of budwood	Breeding, conservation	Breeding	Working and resource collections
Documentation		Computerisation underway	Variable	None
Availability	Generally available	<i>Rubus</i> available except for protected cultivars, strawberries mainly not	Mostly available	Insufficient material as yet
Location of chief world genetic resources	France, Germany, California, Australia	USA	Various	France, U.S.A., Romania, Turkey
Adequacy of conservation in New Zealand	Not adequate, no permanent funding, collection at risk	Adequate	For some collections adequate but many smaller collections of fruit with lesser commercial potential definitely at risk	Not adequate - conservation usually depending on private individuals with limited resources



(See Table 3 for Poplars and Willows)

Table 5: Genetic resources of forest trees

	<i>Pinus radiata</i>	<i>Pseudotsuga menziesii</i>	<i>Pinus muricata</i>	<i>Eucalyptus spp.</i>	<i>Cypress macrocarpa</i> ; <i>Cypress lusi-tanica</i>	Other exotic timber species	Native timber spp.
Living collections	extensive; country-wide; systematic collections and local plantations	scattered; systematic collections and local plantations	scattered; systematic collections and local plantations	various sites; systematic collections and local plantations	substantial	various, being extended	native forests <i>in situ</i> ; (potential as plantations limited)
Seed storage	----- Both New Zealand and overseas; wild collections and breeding material ----- (Forest Research Institute, Rotorua)						N.A.
Regeneration	selective seed collection; pollination not controlled which is potentially a major problem	selective seed collection; pollination not controlled	selective regeneration planned	selective regeneration; isolation not sought (insect pollination)		no systematic regeneration of most species at present, but no urgency	N.A.
Representation	----- Both New Zealand and overseas; wild collections and breeding material -----						New Zealand
Value and Uniqueness	highly significant, little unique owing to cooperative germ plasm sharing	significant; broad geographic representation, in-depth over part of range	very significant; none unique but may be most substantial collection outside natural stands	not unique; but significant for some species	some unique	little if any unique, but some collections very important	unique
Use	very intensive breeding and conservation	some intensive breeding and mass-selection and maintenance of broad genetic base	mass-selection, and maintenance of genetic base	some intensive breeding, mass-selection and maintenance of broad genetic base	breeding and conservation	species testing, mass-selection and maintenance of broad genetic base	N.A.
Documentation	Good records; computerised but often not sifted. Some records for former State forest now out of date						Distribution and biology being covered in Biol. Fl. N.Z.



	<i>Pinus radiata</i>	<i>Pseudotsuga menziesii</i>	<i>Pinus muricata</i>	<i>Eucalyptus spp.</i>	<i>Cypress macrocarpa;</i> <i>Cypress lusi-tanica</i>	Other exotic timber species	Native timber spp.
Availability	Freely available except for highly select breeding; sometimes subject to temporary constraints on seed collection or production						Generally available, but subject to consultation with Maori in interim while Waitangi Tribunal Claim No. 262 remains unresolved
Location of chief world genetic resources	California and Mexican islands (natural stands); N.Z. & Australia, Chile	U.S. & Canada (natural stands); Europe and N.Z.	California (natural stands); Australia & N.Z.	Australia (natural stands) New Zealand for some species	California and Mexico	various; conifers chiefly U.S., Mexico & Cent. America	New Zealand
Adequacy of conservation in N.Z.	good at present; logistics of long-term conservation of living genetic resource material may be a problem in future	generally adequate. Good scheme initiated in U.S.A. but future access problematic	adequate; no urgent problems seen	progress satisfactory	generally adequate, but more Clusitanica desirable	patchy; genetic base often narrow and sometimes suspect. Pressures now exist for liquidation.	scattered relict stands may be efficient for gene conservation but we lack geneological knowledge



Table 6: Indigenous plants (other than forest trees), and exotic ornamentals

	Indigenous plants	Exotic ornamentals
Living collections	Extensive <i>in situ</i> conservation, much of which enjoys formal legal protection as being part of national and local reserves systems but many ecosystems are under pressure from exotic animals and plant pests in particular. Much indigenous vegetation on private land is unprotected. Some conservation in botanic gardens and scientific collections, e.g. Otan Native Botanic Garden, Wellington. Marine plants enjoy little formal protection.	Various private collections and public botanic gardens and Crop & Food Research. New Zealand has an important resource of exotic ornamentals in both public and private collections. The number of exotic plants is currently estimated at a minimum of 25,000. At least 2,420 of these have now naturalised and some are major pests.
Seed storage	Very little; more research needed; some forest species may be intractable.	Very little
Representation	A large part of the flora is represented in <i>ex situ</i> collections, but information exchange between collections is poorly coordinated. As an example Otari currently has 3,500 accessions representing about 850 vascular species, about a third of the known vascular flora. See text of this document for details of other representation in <i>ex situ</i> collections.	Examples of major plant collections include: Pukeiti Rhododendron Trust, New Plymouth The Lathyrus collection of Dr K Hammett Dunedin Botanic Garden, especially rhododendrons and Australian plants Salvia collection at the Auckland Regional Botanic Gardens. See tables in Annex 3.
Value and uniqueness	Mostly unique; 76% of the vascular plant species of New Zealand are endemic, and 43% of marine algae.	Local value. Some species are under threat in their country of origin.
Use	<i>Ex situ</i> collections used for research, breeding and conservation.	<i>Ex situ</i> collections used for research, breeding and conservation.
Documentation	Varies, generally not easily accessible, although more collections are computerising collection data, so it is becoming easier to access data. All the major botanic gardens and the national flax collection now have computerised data bases. Some ornamentals on Royal New Zealand Institute of Horticulture list e.g. Hebe, with >500 cultivars.	Landcare has a list of species. The Royal NZ Institute of Horticulture has an interim list of significant plant collections (over 500) and checklists of names and features of cultivars.
Availability	Varies	Generally available
Location of chief world genetic resources)	New Zealand	Various
Adequacy of conservation	Not adequate for a number of species, although few of these have known economic uses at present. 133 species of terrestrial plant are classed by Department of Conservation as Category A or B on the national threatened species list.	Many species are represented by a few individuals and are in danger of being lost from New Zealand.



This listing includes responses to the questionnaire plus collections over 100 species or over 200 accessions in the NZ Plant collections survey of March 1993 (Hammett 1993). There are other resources not listed here, including dispersed resources of exotics (e.g. MacKay 1990 survey). Further information is in Forde (1986), including status of collections, adequacy of conservation and uniqueness; and in DSIR (1989). Neither this, nor other surveys, took into account the percentage of stored germplasm that is actually dead.

Table 7: Details of genetic resources in New Zealand

Institution + Source	Scope + Resource	Role	Staff + Annual Funding (NZ\$) +Security	Co-ordination + data
DOC, overall responsibility for native organisms MfE, 1992	NZ natives (all groups) estimated 50,000 spp. in all, only 16,700 described; > 3,000 introduced.	Protection	Insufficient~200-600 spp. endangered.	Large amount of information in various db.
DOC Native Plant Nursery, Taupo (Leased out to private sector. Minister has stated that collections will stay if they have a proven conservation value. (M.Oates, pers. com. 1993)	NZ native plants, c.350 spp. (280 according to R. Hay)	Includes specialist colls. of rare plants, wetland plants and flaxes. Revegetation, commercial plant sales and advice.	12 staff. Funding from within and outside DOC but commercially self-supporting.	
Motukarara Native Plants Nursery W. Harris	Native Plants			
National Ethnobotanical Garden - Te Wao Nui A Tane	Indigenous plants of traditional value. Planning phase.	Planned as an area for education and conservation.		
National flax collection	Large collection of traditional cultivars of flax.	Conserving cultivars of flax.		Cultivar database
DOC Species and Island Recovery Programmes DOC Corporate Plan 1991-92	Native species. Survey, recover, transfer, manage, monitor, CITES permits. 458 programmes.	5% of programmes expected successfully to improve conservation status of threatened species. 60% of progr. expected to meet objectives.	Govern. 13.8 m	
DOC Implementation of Legal Protection DOC Corporate Plan 1991-92	Legal protection, PNA surveys and extensions of close to 53,000 ha in one year.		Govern. 5.1 m, approximately 1/3 of country surveyed for PNA, implementation difficult.	
DOC Conservation Estate DOC Corporate Plan 1991-92	native spp. (c.50,000 estim. see above) in parks and reserves (>5 m ha) Includes historic sites.	Management, monitoring, weed, pest, and fire control, restoration and related research.	>>1,240 (only fire fighting support) Govern. 24.8	db on threatened plants, native species, priority listings and PNA surveys



Institution + Source	Scope + Resource	Role	Staff + Annual Funding (NZ\$) +Security	Co-ordination + data
Landcare NZ, Carol Lough, Bill Lee	NZ native + South Pacific Largest NZ Herbarium 530,000 specim.	Economic plants, ethnobotany, reference coll., taxonomy and systematics, patterns of biodiversity, ecology, threatened plant ecology, biogeography.	5 programmes, 23 staff. Government funding 2.5 m (1 in Biodiversity programme, 0.2 in economic botany of native plants and ethnobotany).	Large range of groups and competitive funding system inhibits interdiscipl. and co-ordinated work, several large db
Otari Native Botanic Garden, Mike Oates	c1,200 spp and cultivars Hebe 80 spp., 50 cvs; Olearia 30 spp. Carmichaelia 20 spp. Coprosma 35 spp.			
Landcare NZ, Lincoln + Havelock North, Geoff Walls	NZ native plants gardens and nursery.			
Aloe collection, Martin Walker	110 species		Private	
Cacti collections	Various, unknown numbers but mostly included in Botanic Gardens as well.			
Dahlia collection, Auckland Botanic Gardens	12 spp., c.400 acc.		Auckland City	
Dahlia collection, K. Hammett	12 spp., c.500 acc.		Private	
Dahlia collection, L Brown	c.300 acc.		Private	
Iris collection, Maria Fairburn	250 spp., 50 acc.		Private	
Lathyrus collection, K. Hammett	c.74 spp., c750 acc.		Private	
Lithops collection, S. Miehle	380 spp.		Private	
Malus collection, Hort Research, Palmerston North	c.500 acc.		Government	
Prunus collection, Hort Research, Palmerston North	c.400 acc.		Government	
Pyrus collection, Hort Research, Palmerston North	c.200 acc.		Government	
Rhododendron, Dunedin Botanic Garden	120 spp., 300 acc.		Dunedin City Council	
Rhododendron, New Plymouth DC	>40 spp., >200 acc.		New Plymouth DC	
Rhododendron, Pukeiti Rhodo Trust	>400 spp., >1000 acc.		Private	
Salvia collection, Auckland Botanic Garden	c100 species		Auckland City Council	



Institution + Source	Scope + Resource	Role	Staff + Annual Funding (NZ\$) +Security	Co-ordination + data
Exotic Ferns, New Plymouth	>120 species		New Plymouth DC	
Native Ferns, New Plymouth	>111 species		New Plymouth DC	
Orchid collection, New Plymouth	>520 spp., >980 acc.		New Plymouth DC	
Climbing plants, C & J Nicholls	c.400 acc.		Private	
Dwarf conifers, Waitomo	c400 acc		Waitomo DC	
Crop & Food Research Biodiversity Programme, S Halloy	1,300 acc., 650 spp., 393 gen., 140 fam., mainly S. America. Gondwana arboretum.	Conservation and supply of unexploited and under-utilised plants for diversification. Research patterns of biodiversity, physiology, taxonomy, biogeography, ethnobotany.	2.3 staff. Feeds into several evaluation programmes. Govern. \$161,000, short term, decrease of 54% over 1991.	Relational db established in view of linking NZ genetic resources. More than 3,000 spp. included. Links with USDA, IUCN, INTA.
FRI Rotorua, R.D. Burdon, Ian Nicholas	Timber 120 spp. 1,600 ha of progeny trials, and provenance resource, under covenant. Exotic, some native (eg. <i>Agathis</i>). Some in vitro. Many introductions and trials throughout NZ (Vincent & Dunstan 1989) Incl. <i>Pinus</i> , <i>Jaglans</i> , <i>Paulownia</i> , <i>Acacia</i> , <i>Eucalyptus</i> .	Major colls., mostly as live material, some of international significance, in vitro collections a minor component. Research, breeding, collections management Provenance research.	6Sc + 6 T. Govern. + industry funded, limited. Stretched in some areas. Much work 'on hold'. Covenant protection often shaky. Colls. at risk. Financial and resource constraints. Having to deal with unscheduled gifts or arrangements of seedlots.	Information on germplasm part way on relational db compatible for growth data.
FRI Rotorua	542 spp. arboretum			
C.E. Ecroyd	c.200 spp. arboretum			
Rotorua MRST 1993	Fungal collections of international importance.			
Exotic Nurseries, Kaitaia. Dave Austen	>2,800 spp., >1,200 gen., 128 fam.		Private, commercial.	
Eastwoodhill Arboretum, Gary Clapperton, McKay 1989	c.2,600 spp., and cultivars, 413 gen, 119 fam. particular emphasis on endangered species, mostly exotic, 75% of spp. northern hemisphere.	Crucial because of its emphasis on endangered species.	Secured under act of Parliament.	
Dunedin Botanic Garden, Alison Evans	2,100 acc., 1,400 spp., 700 gen., 124 fam.		Dunedin City Council	Db on Paradox



Institution + Source	Scope + Resource	Role	Staff + Annual Funding (NZ\$) + Security	Co-ordination + data
Hort Research, Alan Seal, Paul Clucina	Fruit plants, ~1,850 acc. in 12 genera. Incl. Avocado, Feijoa, Kiwifruit, Pepino, Tamarillo, Apple, Pear, Stone-fruit, Hops, Rubus (details of larger general colls. elsewhere in this table).	Essential national resource for plant improvement. Significant worldwide repositories (e.g.. Pepino). Taxonomy, evaluation, maintenance.	Govern. to research programmes only. No regard to lack of continuity and long term (expensive) maintenance. Little duplication Long lived perennials are expensive to maintain and research.	Most plant material freely available to bonafide researchers. Emphasis placed on developing computerised databases.
Landcare Soil conservation coll. DSIR 1989, Bruce Bulloch	Soil protection + improvement + shelter plants. 1,800 acc, 600 spp, 50 gen, 15 fam.	Select and breed new material and supply to users. Collection of Willow and Poplar of world importance.	Lack of continuity a major problem.	
Crop & Food Research, R.B. Wynn-Williams	Crops, 6 spp, 3 gen in genebank. Forde 1986 cites 10,250 accessions in 7 genera; DSIR 1989 cites 16 gen.	Supply breeding material.	1 Sc. Govern. \$124,000 Funding constraints.	Integration with global collections should be focused at specific crops (as per IBPGR policy).
AgResearch, NZ Forage Germplasm Centre (Plant Genetic Resources), W. Williams, R.J.M. Hay, M. Forde	Forage plants seed 61,000 acc (13,400 from overseas), 1,480 spp, 285 gen, 48 fam. Purpose built collection management db.	Working collection to supply breeders and evaluators. Vital for plant improvement. Base coll. for long term storage.	2.3 staff. Training prog. for Chinese. Govern. \$297,000 (ensured for 3 years). Inadequate for replenishment of stock.	Strong links to IBPGR and related CGIAR centres. Serves as Australasian Centre for temperate pasture spp.
AgResearch Accelerated Screening, R.J.M. Hay, M. Forde	Forage plants, exotic (China, Russia, Argentina) 250 lines.	Screens new accs. to assess potential for inclusion in forage plant improvement programmes.	0.9 staff + co-operation from other progr. Govern. funded \$90,000.	
Landcare Plant Protection Fungal Herbarium (PDD) and Fungal and Bacterial Culture Collection (ICMP), Peter Buchanan	Dried fungal herbarium NZ and Pacific (60,000 specim.) (4,000 spp of fungi recorded of 20,000 estim.); 4,000 fungal cultures mostly NZ; 5,500 plant pathogenic bacteria cultures (NZ and internatl.)	Conservation of life support species. Reference, taxonomy. Most comprehensive coll. of NZ fungi. Applied uses (biocontrol, edible). Internatl. coll. of cultures of plant pathogenic bacteria (ICMP).	6.7 staff (3.7 S, 3 T). Govern. \$570,000 Inadequate for task. Unstable. Pressure for more applied research. Admin. demands.	Good contacts with analogues internationally. Computerised database. NZ Plant diseases db. Close links with International Mycological Institute part of internatl. network of herbaria and culture colls. CSC link supported.
Landcare Plant Protection NZAC, NZNC, John Dugdale	Preserved Invertebrate collections (mainly arthropods and nematodes) NZ and Pacific. 6m specimens. 3db (lit., Pacific pests, collection). 11,000 native NZ insects recorded out of 20,000 estimated.	Reference taxonomy, identification for quarantine, agricultural research, conservation. Field surveys, guides, revisionary monographs.	11.5 staff (7.9 S, 3.6 T) Govern. \$1.4 m. Inadequate, unstable, pressure of more applied research, admin, demands. Need larger accommodation. Internatl. funding would be justified.	Good contacts with analogues internationally, incl. Orston, British Museum of Natural History, IIE, NHM, CSIRO, SPC. International network with herbaria and of other collections. Computerised db compatible with GIS.



Institution + Source	Scope + Resource	Role	Staff + Annual Funding (NZ\$) +Security	Co-ordination + data
National Museum of New Zealand (Wellington) MRST 1993, Young 1988	Reference collections of international importance, >2,000,000 specimens of which half are insects and 235,700 are plants.		10.5 staff equiv.	
Auckland Museum MRST 1993	Reference collections of international importance.			
Crop & Food Research Novel Crops programme, Jim Douglas	New underexploited plants and animals, mainly for extracts, medicinal, spices, aromatics and ornamentals. Both native and exotic.			

Note: The survey leading to this table did not include some important live collections in Botanic Gardens, QE II trust land, major nurseries, private collections and several NGO's.



ANNEX 2

Description of the System of Research Institutes and Science Funding in New Zealand

New science structures have been established that enhance the accountability to the Government of research agencies which receive public funds. Science policy advice is separated from the funding and delivery of Government science. The new approach aims to focus research in a cost-effective way into areas that give the best environmental, social and economic benefits to New Zealand.

The Ministry of Research, Science and Technology (MORST) provides policy advice on priorities and funding, and the Foundation for Research, Science and Technology (FRST) allocates the Public Good Science Fund (PGSF) funding to specific science activities. Under the contestable funding system, researchers compete to win contracts from FRST to undertake agreed research programmes, “public good” research, or projects in accordance with the Government’s national science priorities. FRST funds projects on a fully-costed basis.

Science and technology and funding policy

The overall goal set for science and technology policy is to ensure that science and technology are able to contribute effectively to economic prosperity, a sustainable environment, and cultural and social well-being. Conservation of biodiversity requires consideration of issues over the long term. The Government has adopted a strategic approach, identifying priorities for its science and technology investment, including a guarantee of funding into the future. An increasing proportion of the PGSF (approximately 70 percent) is being allocated on a longer term basis; three to five years. The Government has also implemented a process of identifying National Science Strategies for cross-cutting areas of science. The Crown Research Institutes as science provider organisations focus on environment and development as core areas of their strategic plans which also provides a long-term scientific focus on sustainability issues.

Approximately 1.5 percent of the total Government budget is appropriated to R&D funding. Private sector spending finances only 34% of New Zealand’s total spending on R&D. This compares with the OECD average of 52



percent contributed by the private sector. The Government has made a commitment to increasing the total investment in research by NZ\$100 million over the period July 1996 to July 1998. The Government spends over one and a half times the average proportion of research funding of other OECD countries on “environmental protection”, and over four times the proportion of other OECD countries on “agricultural research”. This reflects the importance of New Zealand’s natural resource base to the economy and the need for its continuing sustainable management.

Government provides direct funding to the Department of Conservation to carry out research on indigenous plant ecology.

Universities carry out research through funding from the education portfolio and through funds received from the Health Research Council, the PGSF and other government and private sources.

The Cawthron Institute is an important private research institute, which carries out research into marine microalgae among other things.

The Crown Research Institutes

In July 1992 ten Crown Research Institutes (CRIs) were formed from science assets of the former Department of Scientific and Industrial Research (DSIR), and other Government scientific agencies and departments. The CRIs are independent corporate bodies, and are required to comply with the provisions of the Companies Act in relation to their financial operations. The exotic plant genetic resources in genebanks were transferred from Crown ownership to the CRIs. A condition of FRST funding (where this exists) is that collections and databases of national importance be maintained, and made freely available.

- CRIs carrying out research in plant related fields
 - **New Zealand Institute for Crop and Food Research Ltd - Mana Kai Rangahau (Crop & Food Research):** Relevant research areas: arable and vegetable crops including some novel (for New Zealand) crops, some ornamentals (native ornamentals, cut flowers), plant extract analysis (with Otago University).
 - **The Horticulture and Food Research Institute of New Zealand Ltd (Hort+Research):** Relevant research areas: fruit crops and some nut crops, some ornamentals, multiple purpose trees (primarily poplars and willows for soil conservation, shelter and timber).



- **New Zealand Pastoral Agriculture Research Institute Ltd (Ag.Research. Research):** Relevant research areas: plants for animal forage and soil conservation.
 - **New Zealand Forest Research Institute Ltd (NZFRI):** Relevant research areas: plantation forestry, wood processing and products.
 - **Landcare Research New Zealand Ltd - Manaaki Whenua (Landcare Research):** Relevant research areas: indigenous plant taxonomy, ethnobotany, some ornamentals (native).
 - **National Institute of Water and Atmospheric Research Ltd - Taihoro Nukurangi (NIWA):** Relevant research areas: freshwater algae and marine microalgae.
- CRIs for other research areas
 - **Institute of Geological and Nuclear Sciences Ltd (GNS)**
 - **New Zealand Institute of Social Research and Development Ltd (SR&D)**
 - **New Zealand Institute for Industrial Research and Development Ltd (Industrial Research Ltd)**
 - **Institute of Environmental Science and Research Ltd (ESR)**



ANNEX 3

Public Good Service Fund - Funded Databases and Collections of Significant National Importance

In accord with the requirements in the Government's *Statement of Science Priorities 1993/94 - 1997/98*, the following are PGSF-funded databases of significant national importance. These databases and collections will be separately identified and funded on a priority basis by the Foundation for Research, Science & Technology.

Output 6 - Forage Plants

Margot Forde Germplasm Centre (New Zealand)

Output 7, 8, 13 - Horticulture, Arable and Other Food Processing

National Collections of Fruit Crop Germplasm

Outputs 9, 15 - Forestry Research

NZ Forest Research Institute Herbarium

Outputs 25, 26, 27, 28 - Social Sciences

Ethnobotany Database and New Zealand Flax, Living Plant Collection

Output 30 - Geological Structures and Processes

Regional Geological Map and Data File

New Zealand Fossil Record File

New Zealand Paleontological Database and Collection

National Petrology Reference Collection and PET Database

New Zealand Geomagnetic Database

National Earthquake Information Database

New Zealand Volcano Database

Output 31 - Land Use, Flora and Fauna

New Zealand Land Resource Inventory

National Soils Database

Research Herbarium for Plant Biosystematics

NZ Arthropod Collection, NZ Nematode Collection & Specimen & Information Database

International Collection of Micro-Organisms from Plants and Associated Database

National Fungal Herbarium and Associated Databases



Output 32 - Marine and Freshwaters

Marine Benthic Biological Collection

Output 33 - Climate and Atmosphere

Climate Database



ANNEX 4

Excerpt from Government Environmental Strategy, "Environment 2010"

4.1 PROTECTING INDIGENOUS HABITATS AND BIOLOGICAL DIVERSITY

Goal

To protect indigenous habitats and biological diversity by:

- maintaining and enhancing the net area of New Zealand's remaining indigenous forests and enhancing the ecological integrity of other remaining indigenous ecosystems;
- promoting the conservation and sustainable management of biological diversity so that the quality of our indigenous and productive ecosystems is maintained or enhanced.

Issues

New Zealand's geographical isolations and diverse terrain have contributed to a unique range of habitats and species of plants and animals. The indigenous habitats of New Zealand include our forests, tussock grasslands, waterways, alpine tops, estuaries and coastal ecosystems.

In the occupation and settlement of New Zealand, many indigenous habitats were modified, leading to a loss in biological diversity. Today, our economic prosperity depends on productive ecosystems including our agricultural land and much of our commercial forest land. Maintaining and enhancing biological diversity is a vital step in protecting both our native and productive ecosystems.

The term 'biological diversity' (or biodiversity) encompasses the variety and abundance of plants, animals and microorganisms and their associated ecosystems. The larger, more diverse and complex a habitat is, the more resilient it is to change and stress. The possibility of global climate change, drought, and the introduction of invasive plant and animal species are some examples of the many stresses placed on the New Zealand environment.



During the 1980s and early 1990s, New Zealand protected significant areas of indigenous forest, or required its sustainable management. More effective protection is now possible for wetlands and many other lowland habitats under the provisions of the Resource Management Act.

The protection and enhancement of important habitats and of indigenous biological diversity is not free of cost, and this needs to be recognised. At the same time, New Zealand benefits economically from clean air, productive soils, and the many other services that healthy ecosystems and habitats provide.

Risks

The risks differ between those types of ecosystems that are relatively well protected and those that are not.

The risks are:

- loss of some types of ecosystems, such as wetlands and tussock grasslands;
- loss of biodiversity and decline in health of protected ecosystems caused by introduced plants and animals, such as possums;
- damage to ecosystems and reduction in biodiversity because people do not understand how ecological systems and processes operate;
- loss of taonga Maori, such as pingao, which grows in sand dunes and is used for weaving;
- damage to sensitive areas, such as fragile alpine ecosystems, as the result of a dramatic increase in the number of visitors;
- damage to ecologically valuable sites and/or ecosystems from developments such as prospecting and mining, siting of telecommunication facilities, hydroelectric power stations and farms;
- damage to the unique flora and fauna that makes New Zealand so distinctive for visitors.

Actions

The legislation governing conservation, protected areas and species, and resource management provides a strong basis for protecting biological diversity and indigenous habitats. Specific legislative amendments may be required over time. However, the key lies in the following actions:

- preparing a national strategy setting out clear goals for maintaining indigenous biodiversity as the first stage in implementing the International



Convention on Biological Diversity, and considering the development of a national policy statement on biological diversity under the Resource Management Act;

- preventing further loss of habitats and species and damage to ecological processes on the mainland, and restoring habitats on offshore islands by
 - controlling, and where possible eradicating, animal pests and problem plants
 - ensuring funding such as Nga Whenua Rahui and the Forest Heritage Fund is well prioritised and targeted to protect forest and other important habitats, such as wetlands, tussock grasslands and dune lands in Maori and other forms of private ownership
 - giving greater priority to research that enhances our knowledge of New Zealand's ecological processes and indigenous ecosystems rather than focusing on individual species in isolation
 - continuing programmes of researching and managing individual declining species on offshore islands;
- developing a priority setting and risk assessment framework to guide conservation management and research;
- broadening public understanding and appreciation of the working of natural systems by providing education programmes, and by encouraging people to visit, and help protect, conservation lands;
- addressing the role of sustainable management (e.g. customary harvest of various native plants and animals) in the context of the conservation and sustainable management of biological diversity;
- developing innovative processes for exploration and resolving conflicts between conservation and 'consumptive' land uses, such as tourism, mining and telecommunications.

Priority

Priority will be given to:

- completing the terrestrial protected areas network, including wetlands, grasslands and other ecosystems under-represented in reserves, developing a comparable network of marine protected areas, and ensuring that coastal ecosystems are protected through the implementation of the New Zealand Coastal Policy;
- containing and controlling plant and animal pests, incorporating any environmentally safe new technologies and control agents, to improve habitat and species protection and retention;



- achieving a broad consensus of public and iwi support, understanding, awareness and involvement in biological diversity conservation;
- meeting the tourism needs of residents and visitors while maintaining the integrity of the environment.



MAP: THE NEW ZEALAND CONSERVATION ESTATE





Acknowledgment

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Ministry of Agriculture

Ministry of Research, Science and Technology

Ministry of Commerce

Ministry for the Environment

Ministry of Forestry

Ministry of Foreign Affairs and Trade

Department of Conservation

Te Puni Kokiri

Foundation of Research, Science and Technology

***Manaaki Whenua* Landcare Research New Zealand Ltd**

New Zealand Institute for Crop and Food Research Ltd - *Mana Kai Rangahau*

The Horticulture and Food Research Institute of New Zealand Ltd

New Zealand Pastoral Agriculture Research Institute Ltd

New Zealand Forest Research Institute Ltd

National Institute of Water and Atmospheric Research Ltd - *Taihoro Nukurangi*

Lincoln University

Victoria University



The Museum of NZ - *Te Papa Tongarewa*

Auckland Regional Botanic Gardens

Wellington Botanic Gardens

Also from:

Aroha Mead

Dell Wihongi

Te Rawawa, Hokianga

Principal claimant for the WAI 262 claim,

and members of various professional bodies, people involved in the horticulture, farming, forestry, ornamental and gardening industries, or involved in the identification and conservation of plant genetic resources.



Abbreviations

ACNGT	Advisory Committee on Novel Genetic Techniques
CGIAR	Consultive Group International Agricultural Research
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CRI	Crown Research Institutes
DOC	Department of Conservation
DSIR	Department of Scientific and Industrial Research
ERMA	Environmental Risk Management Authority
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FRST	Foundation for Research, Science & Technology
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
HSNO	Hazardous Substance and New Organisms
IAG	Interim Assessment Group for the Field Testing or Release of Genetically Modified Organisms
ICPPGR	International Conference and Programme on Plant Genetic Resources
MAF	Ministry of Agriculture
MoRST	Ministry of Research, Science & Technology
NIWA	National Institute of Water and Atmospheric Research Ltd



OECD	Organisation for Economic Cooperation and Development
PGR	Plant Genetic Resources
PGSF	Public Good Science Fund
PNA	Protected Natural Areas
PVR	Plant Variety Rights
R&D	Research and Development
RNZIH	Royal New Zealand Institute of Horticulture
TRIPS	Trade Related Aspects of Intellectual Property Rights
UPOV	International Convention on the Protection of New Varieties of Plants

Maori words

Aotearoa	New Zealand
iwi	tribe/race of people/nation
tangata whenua	local person
taonga	treasures, other properties
te tino rangatiratanga	to possess and control what is yours
mauri	physical life force



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