Ministry for Primary Industries
Manatū Ahu Matua

Sustainable Management of New Zealand's Forests

New Zealand's Third Country Report on the Montreal Process Criteria and Indicators

Acknowledgements

This report was prepared primarily by the following Ministry for Primary Industries staff from the Policy and Trade Branch: Alan Reid, Gerard Horgan, Parnell Trost, John Novis, Steven Cox, and Ian Payton (consultant).

Advice and peer review were provided by Elaine Wright and Rod Hay (Department of Conservation), and Nigel Searles and Joanna Buswell (Ministry for the Environment). Their input was invaluable, but the views expressed in the report are those of the Ministry for Primary Industries and are not necessarily endorsed by those who reviewed the report.

External editing was undertaken by Jenny Heine. Thank you to Alan Reid, Ian Platt, Mark Smale, Ian Payton, Terry Wreford Hann and all others who provided photos for this report. The front cover image is by Ian Platt, showing mountain beech forest at Castle Hill Basin in Canterbury.

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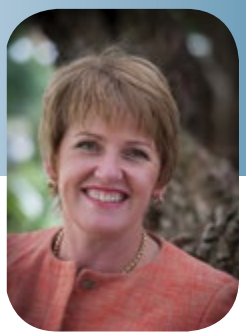
New Zealand Government

FOREWORD



Remarkably, forest managers were thinking about the sustainability of the supply of timber from forests in Germany in 1713. Since then, the concept of what constitutes "sustainable forest management", and its objectives, has evolved. Sustainable forest management now recognises the diverse range of values, goods and services provided by forests and forest ecosystems.

The Montreal Process provides a framework of criteria and indicators for countries to report internationally on progress towards achieving sustainable forest ecosystem management for both planted and natural forests.

This is New Zealand's third national report under the Montreal Process. The report is a valuable contribution to our understanding of sustainable forest management, and it includes information on the full set of seven criteria, and 54 of the indicators. The report provides an overview of the current state of New Zealand's forests and covers a range of the environmental, commercial, social and cultural issues associated with those forests.

This report is an opportunity to acknowledge the achievements and developments in the period since the last report in 2008. These include:

- a significant focus by both Government and industry on the health and safety of workers in the forestry industry;
- a 50 percent increase in sustainable harvesting;
- the standing volume of plantation forests has increased due to an increase in the average age of the estate;
- improvements in the quality of the data relating to both the forests and their wider ecosystems;
- improving the understanding of threats to natural forests and control options;
- efforts to improve the management of wilding pines;
- the ongoing focus on biosecurity;
- $12.27 million being committed to forestry innovation projects under the Primary Growth Partnership Programme, of which $6 million was from industry; and
- the introduction of a forest growers' levy which was expected to raise $8.2 million for industry-good activities in 2014.

The Montreal Process, and this report, provides an important benchmark against which we can demonstrate our progress in future years, and contribute to the international understanding of sustainable forest management.

Hon Jo Goodhew
Associate Minister for Primary Industries

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THE STATE OF NEW ZEALAND'S FORESTS

The Montreal Process criteria and indicators provide a common framework for members to monitor and report on trends in progressing towards sustainable forest management. This is New Zealand's third national report, following previous reports in 2008 and 2003. This report includes comment on all 54 indicators, and is an assessment as at mid-2014.

Overview of New Zealand's forests

New Zealand has a total of 10.1 million hectares[1] of forests[2], covering 38 percent of the land area (Figure 1.1A). This includes 8.0 million hectares of indigenous forests and 2.1 million hectares of plantation forests. These forests are fundamentally different in their biological characteristics, management objectives, and respective roles in fulfilling the needs of New Zealand society.

Indigenous forests

The Crown is the major indigenous forest owner. Through the Department of Conservation, it manages about 5.2 million hectares (76 percent) of New Zealand's tall indigenous forests for conservation of biodiversity, heritage and recreational purposes. The bulk of this Crown-owned forest resource is protected in perpetuity in national parks, scenic reserves and other conservation areas (Figure 1.1B).

Plantation forests

New Zealand's plantation forests are dominated by one species; radiata pine *(Pinus radiata),* which accounts for 90 percent of the planted area. Ninety-four percent of the plantation forest estate is in some form of private ownership, with the principal management objective being the commercial production of timber.

Following a period of expansion of the plantation forest estate through to the early 2000s, there has been a small decline in net area of about 3 percent. This reflects, in part, the conversion of plantations to more profitable agricultural land uses. Large areas of plantation forest have shifted from listed companies to various forms of private ownership over the last decade.

Key points for each criterion

Criterion 1 Conservation of Biological Diversity

The area of publicly owned indigenous forest protected by legislation has increased by 3.7 percent since 2006, and the majority of tall indigenous forests (76 percent) remains in public ownership.

Measuring and monitoring the health of indigenous forest (and non-forest) ecosystems across New Zealand continues to be a focus. Over the last decade, a national biodiversity monitoring and reporting programme has been developed to assess whether the ecological integrity of public conservation lands is being maintained.

Since 2007, 12 threatened taxa have improved in status as a result of successful species management, and 59 have worsened in status. No taxa were found to have become extinct since the previous threat status assessment.

Criterion 2 Maintenance of productive capacity of forest ecosystems

For both indigenous and plantation forests, harvest levels are well within the limits for sustaining the resource.

1 This report uses satellite imagery-based estimates of forest areas comprising tall indigenous forest, regenerating indigenous forest, and the gross plantation forest area and a broader definition of what constitutes a forest than used previously. For plantation forests, the satellite imagery-based estimates are of gross areas to better match international reporting requirements. Previous reports used net stock areas, which are also used at times (and clearly identified) in this report.

2 The definition of forest is woody vegetation of at least 1 hectare that will exceed 30 percent canopy cover and 5 metres height at maturity. This results in the inclusion of a significant area of regenerating indigenous forest.

Standing volumes in plantation forests have increased steadily over recent years and this growth is expected to continue as more forestry plantings approach maturity. Harvested volumes have also increased, but at a slower rate, as much of the forest is still in its first rotation.

The area of indigenous forest with approved plans or permits for sustainable timber production declined by 26 percent between 2007 and 2013, and currently stands at 84 000 hectares. Recent analysis suggests that about 250 000 hectares of privately owned indigenous forests have the potential to be managed for sustainable timber production.

Criterion 3 Maintenance of forest ecosystem health and vitality

Annual economic losses from diseases affecting plantation forests are estimated at $83 million; slightly more that the estimate for 2008 of $82 million. In 2013, less than one percent of the total plantation forest area was affected by insects, and about ten percent of the total plantation forest area was affected by diseases. The diseases involved mostly affect growth and wood quality.

Despite ongoing control efforts, possums, ungulate and other vertebrate pests significantly affect indigenous forests. However, understanding of the distribution, abundance and impact of possums in New Zealand indigenous forests has improved greatly since 2005 and the more recent implementation of a biodiversity monitoring and reporting programme. It is estimated that 81 percent of the indigenous forest area is affected by possums.

Criterion 4 Conservation and maintenance of soil and water resources

In 2011, the government issued a National Policy Statement for Freshwater Management, and amendments in 2014 provide direction to local government on the management of water resources.

New Zealand has a number of documents that address the mitigation of impacts from plantation forestry operations on soils and water. Since 2008, two new documents have been published: the *New Zealand Forest Road Engineering Manual,* and the *New Zealand Standard NZS AS 4708:2014 Sustainable Forest Management.* Updates have been completed on the *New Zealand Environmental Code of Practice for Plantation Forestry*, and the *Standards and Guidelines for the Sustainable Management of Indigenous Forests.* These documents are supported by, and widely promoted by, the industry.

Criterion 5 Maintenance of forest contribution to global carbon cycles

Forest carbon stocks increased between 1990 and 2012 by 7.4 percent to 3 298 million tonnes of carbon. Of this total, 86.2 percent was in indigenous forests and 13.8 percent in plantation forests.

About 7 percent (57.83 petajoules) of New Zealand's primary energy supply comes from forest biomass. This has increased 44 percent since 2008.

Criterion 6 Maintenance and enhancement of socioeconomic benefits of forests to meet the needs of societies

Production from New Zealand's plantation forests has increased significantly since 2008. A total of 30.5 million cubic metres of roundwood was harvested in the year ended March 2014. This represented 6 percent of the estimated standing volume of plantation forests of 494 million cubic metres.

The majority (57 percent) of this production was exported as logs or chips. The remainder was processed into sawn timber (4.1 million cubic metres sawn), panel products (1.9 million cubic metres), pulp (1.5 million air dried tonnes), and paper and paperboard (0.7 million tonnes).

Production from indigenous forests was 24 000 cubic metres, or less than 0.1 percent of the total harvest.

The harvesting and processing of wood products generated:

- export earnings from logs and wood products of $5.2 billion for the year ended June 2014;
- work for 17 415 employees in forestry and first-stage processing for the year ended February 2013;
- a contribution to gross domestic product (GDP) from forestry and logging plus wood and paper products of $3848 million for the year ended December 2013, or 2.6 percent of total GDP.

Employment has declined over the past decade, due to a combination of increasing productivity, restructuring within the sector, and changes in market and foreign exchange conditions. Longer term, there is potential for additional employment as plantings in the 1990s mature, and new uses for wood and fibre are commercialised.

Forestry workers experienced an inflation-adjusted 15.7 percent increase in real earnings between 2010 and 2014.

Health and safety in the industry has been a challenge, and reducing the number of fatalities and serious injuries is a high priority for both government and industry.

Debate is growing on how to recognise environmental services, including from forests, and how New Zealand can maintain its natural capital through policy actions and initiatives. Although environmental services remain largely unpriced, targeted grants support the treatment of erosion-prone land. Also, eligible landowners may participate in the New Zealand Emissions Trading Scheme.

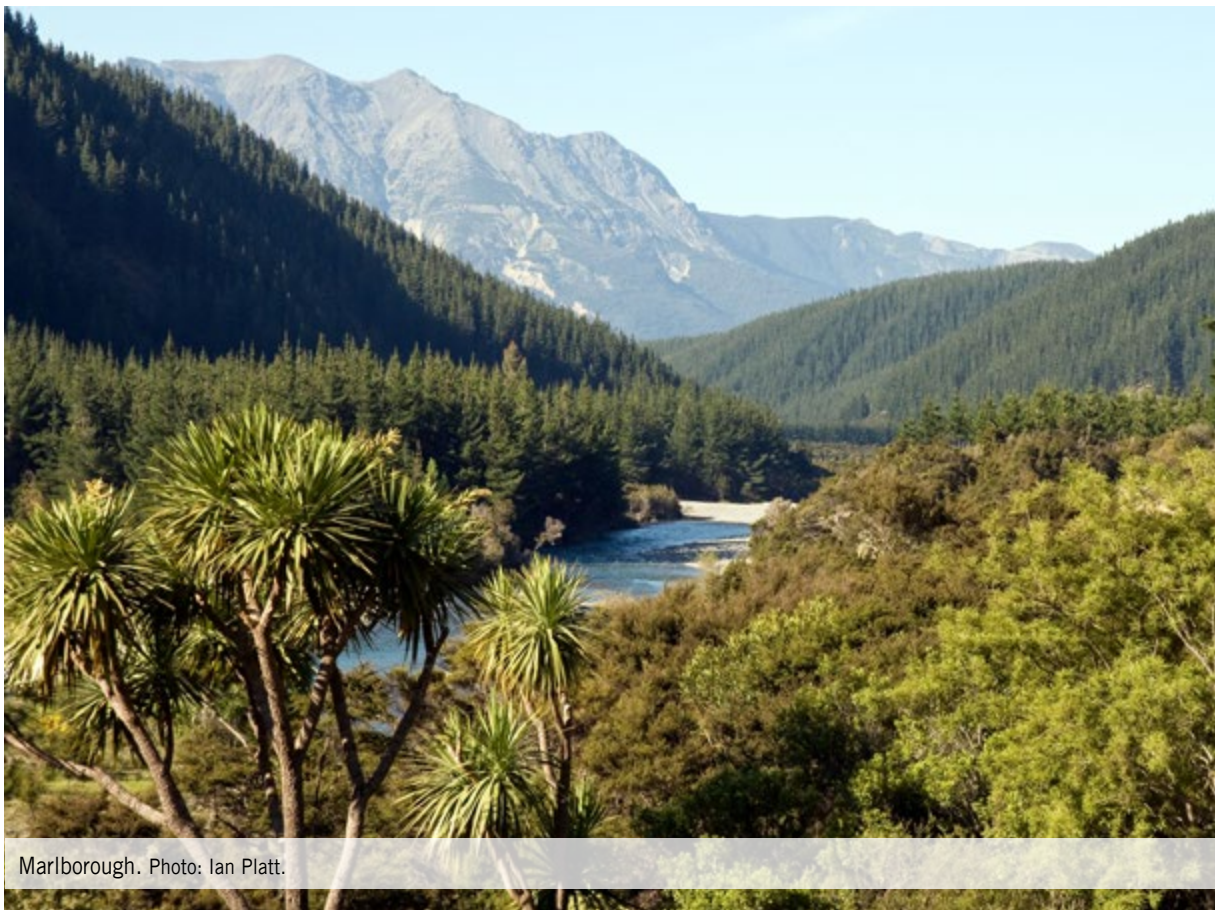
Criterion 7 Legal, institutional and economic frameworks for sustainable forest management

New Zealand has a well-established and robust legal framework supporting the sustainable management of natural and physical resources, including forests. This framework focuses on protecting the status of indigenous forests and managing all land uses in an integrated fashion.

The commercial forestry taxation regime has been stable since 1991. The New Zealand Government is open to foreign investment and regulations are liberal by international standards. New Zealand has a liberal trade policy, and it engages in trade liberalisation forums and is a party to several regional bilateral and plurilateral trade agreements.

New Zealand's property transfer system provides a secure, transparent system for protecting the rights of individual and multiple owners. The system is defined in legislation, providing certainty for investment in the industry. There are clear provisions of redress for both contractual and property issues.

Research and technologies for sustainable plantation forest management are extensive and continue to be developed. A range of new funding mechanisms and initiatives have been implemented that span the forestry value chain. These include the collaborative National Science Challenges, contestable research funds and business-led co-funding programmes such as the Primary Growth Partnership.



Marlborough. Photo: Ian Platt.

Assessed trend of selected indicators

A summary of New Zealand's performance is provided below. Fifteen key indicators have been selected from across the seven Montreal Process criteria to cover range of the environmental, commercial, social and cultural components of sustainable forest management in New Zealand. "Traffic lights" show the trend since 2008 as neutral (▶), positive (▲) or negative (▼) changes.

Trend	Indicator
▼	**Indicator 1.1.a** Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure
▼	**Indicator 1.2.b** Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment
▶	**Indicator 2.d** Annual harvest of wood products by volume and as a percentage of net growth or sustained yield
▲	**Indicator 3.a** Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions
▲	**Indicator 4.2.a** Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources
▲	**Indicator 4.3.a** Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources
▲	**Indicator 5.a** Total forest ecosystem carbon pools and fluxes
▲	**Indicator 6.1.a** Value and volume of wood and wood products production, including primary and secondary processing
▲	**Indicator 6.1.c** Revenue from forest based environmental services
▼	**Indicator 6.3.a** Employment in the forest sector
▼ Injuries	**Indicator 6.3.b** Average wage rates, annual average income and annual injury rates in major forest employment categories
▲ Wages	**Indicator 6.3.b** Average wage rates, annual average income and annual injury rates in major forest employment categories
▶	**Indicator 7.1.a** Legislation and policies supporting the sustainable management of forests
▶	**Indicator 7.2.a** Taxation and other economic strategies that affect sustainable management of forests
▲	**Indicator 7.3.a** Clarity and security of land and resource tenure and property rights
▲	**Indicator 7.4.b** Development and application of research and technologies for the sustainable management of forests

Key forestry statistics[3]

Tall indigenous forest		6.8 million hectares
Regenerating indigenous forest		1.2 million hectares
Plantation forests	– gross area	2.1 million hectares
	– TOTAL forest area	10.1 million hectares
Plantation forests	– net stocked area	1.7 million hectares
	– roundwood removals	30.3 million cubic metres
	– log exports	17.1 million cubic metres
Forest Stewardship Council (FSC) certified plantation forest (sourced from FCS website)		
	– gross area	1.5 million hectares
	– net stocked area	1.1 million hectares
FSC certified indigenous forest		12 000 hectares
Privately owned (tall) indigenous forest		1.65 million hectares
Privately owned indigenous forest under sustainable forest management plans and permits (under the Forests Act 1949)		84 000 hectares
Department of Conservation (DOC)		
	– tall indigenous forest	5.2 million hectares
	– regenerating indigenous forest	0.4 million hectares
	– TOTAL forest area	5.5 million hectares
Queen Elizabeth II (QEII) National Trust covenanted forest area		64 000 hectares
Ngā Whenua Rāhui Fund covenanted forest area		142 000 hectares
TOTAL protected forest area (DOC + QEII + Ngā Whenua Rāhui)		5.7 million hectares

3 Forestry statistics are generally as at March 2014.

Figure 1.1A: Distribution of different types of forest

Note: The thin lines mark administrative regions.

Source: Land Cover Database.

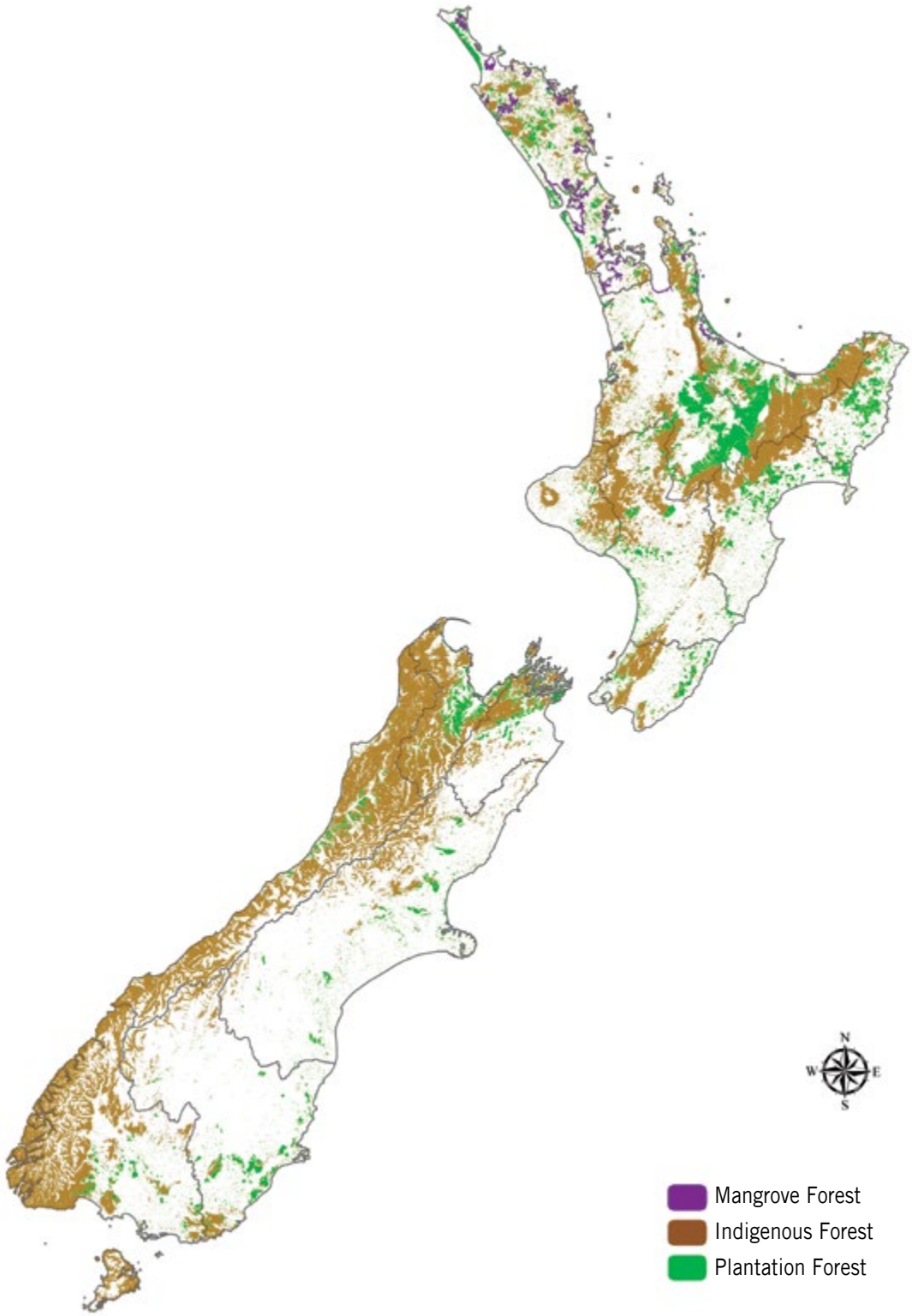
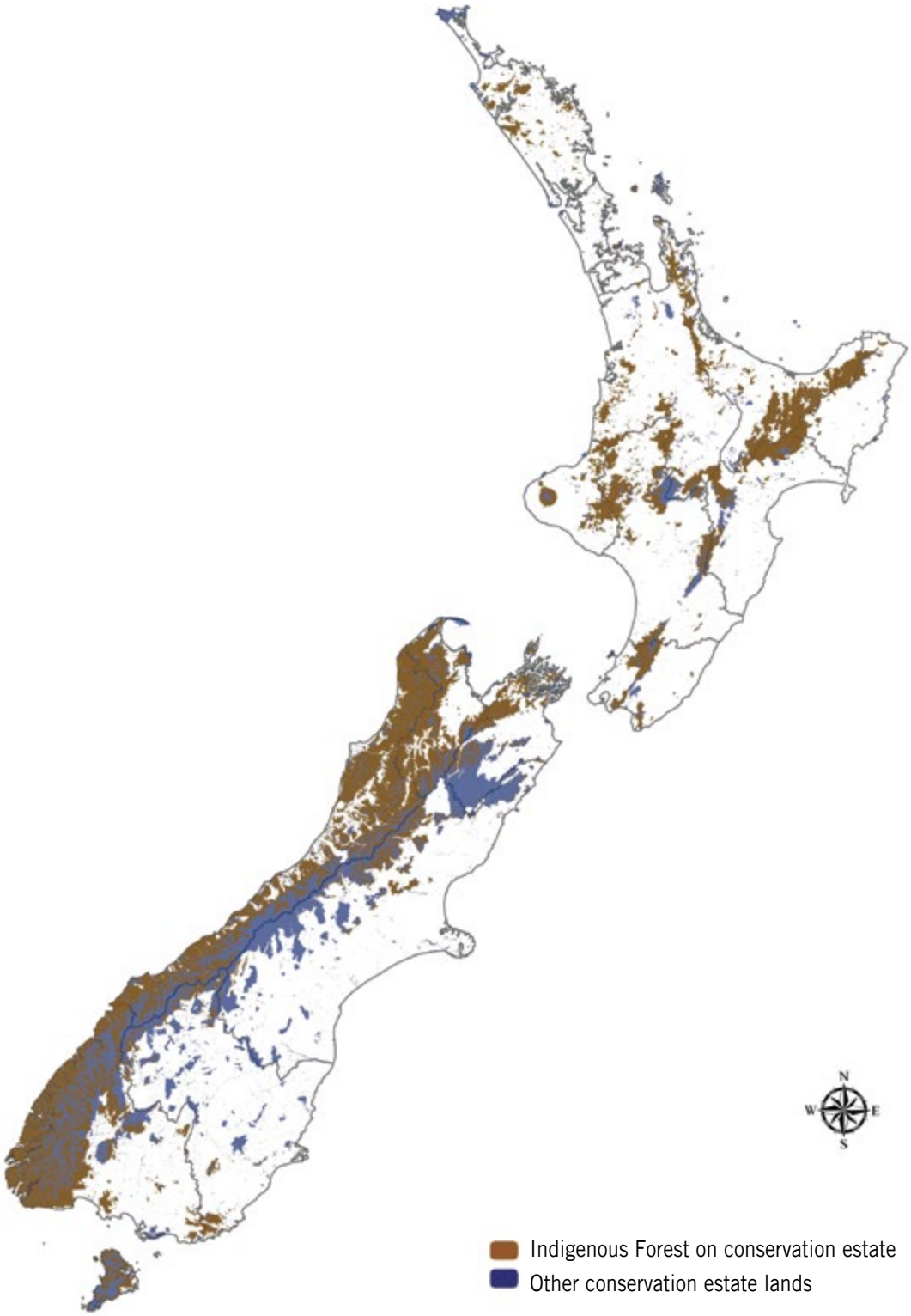


Figure 1.1B: Distribution of public conservation land in New Zealand

Note: The majority of public conservation land is found in the central North Island and west of the mountain range traversing the South Island. The thin lines mark administrative regions.

Source: Land Cover Database.



INTRODUCTION

Forests are home to 70 percent of the world's terrestrial animals and plants, providing the essential components of food, clothing and shelter. Forests are renewable resources and rich, resilient ecosystems. When managed sustainably, they can provide society with essential goods and services – timber, medicine, food, water and employment – and conserve biodiversity, for generations to come.

The 1987 report of the World Commission on Environment and Development, *Our Common Future* (the Brundtland Report), highlighted the urgency of progressing sustainable development without depleting natural resources or harming the environment. Five years later, the United Nations General Assembly sought a report on progress made towards sustainable development and convened the United Nations Conference on Environment and Development (UNCED) in 1992, at Rio de Janeiro (the Earth Summit). The objectives were to build on the hopes and achievements of the Brundtland Report in order to respond to global environmental problems, and to agree major treaties on biodiversity, climate change and forest management.

One of those agreements was the *Principles for Forest Management*. Along with *Agenda 21* and the *Rio Declaration*, it was adopted by more than 178 countries, including New Zealand. The guiding objective of the Principles is:

> …to contribute to the management, conservation and sustainable development of forests and to provide for their multiple and complementary functions and uses (United Nations General Assembly, 1992).

The Preamble to the *Principles for Forest Management* states that:

> Recognizing that the responsibility for forest management, conservation and sustainable development is in many States allocated among federal/national, state/provincial and local levels of government, each State, in accordance with its constitution and/or national legislation, should pursue these principles at the appropriate level of government (United Nations General Assembly, 1992).

Among other things, the Principles state that:

> …forest resources and forest land should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations…
>
> and
>
> The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured.

Following UNCED, Canada convened an International Seminar of Experts on Sustainable Development of Boreal and Temperate Forests in 1993 at Montreal. The seminar focused on criteria and indicators (C&I) and how they can help define and measure progress towards sustainable development of forests.

The Montreal Process

The Montreal Process was subsequently formed in Geneva, Switzerland in June 1994. The Montreal Process is the Working Group on Criteria and Indicators (C&I) for the Conservation and Sustainable Management of Temperate and Boreal Forests.

Membership of the Working Group is voluntary. The 12 member countries are Argentina, Australia, Canada, Chile, China, Japan, the Republic of Korea, Mexico, New Zealand, the Russian Federation, the United States of America and Uruguay. Together, these countries hold 90 percent of the world's temperate and boreal forests and 49 percent of all the world's forests, and are the source of 49 percent of the world's roundwood production.

European countries with temperate and boreal forests work as a region under the framework of the Ministerial Conference on the Protection of Forests in Europe.

Criteria and indicators

The Montreal Process C&I provide a common framework for member countries to monitor, assess and report on trends in forest conditions with respect to the full range of forest values and, in turn, on national progress towards sustainable

forest management (SFM). They represent a holistic approach to forest management, and provide information essential to the focusing of policies and research that promote SFM.

Seven criteria characterise the essential components of SFM, while 54 indicators provide a way to measure those components. The C&I are not performance standards.

The Montreal Process C&I are not static. The Working Group, with important input from the science-based Technical Advisory Committee, periodically reviews and refines the C&I to reflect new research findings, advances in technology, and an increased capability to measure indicators. The result is a contemporary and agreed international C&I framework that can continue to enable member countries to report progress towards SFM. This report uses the third edition of the C&I published in 2009 by the Montreal Process Working Group.

Why is New Zealand involved in the Montreal Process?

There is ever-increasing understanding of the valuable role of forests in providing a wide range of environmental services, both within the forests and also as part of the sustainable management of the wider landscape. It is important for New Zealand to demonstrate its achievements in promoting sustainable forest management.

New Zealand participates in the Montreal Process, and applies the agreed Montreal Process C&I for the sustainable management of all its indigenous and plantation forests as part of this. New Zealand finds the holistic approach to Montreal Process C&I an effective means for reporting the many environmental services of forests, as well as how these interact.

Domestically New Zealand's experiences in the Montreal Process and the preparation of country reports have allowed:

- more effective communication on the status of efforts towards sustainable forest management;
- monitoring of the trends in the status of the indicators in order to focus domestic policy development and research initiatives towards areas of weakness, or a weak evidence base, in sustainable forest management;
- education of the public about sustainable forest management and the different environmental services provided by forests;
- demonstration of how C&I-based reporting can be the basis for other forms of natural resource management.

The Montreal Process also attracts an international audience with an interest in assessing sustainable forest management and contributes to the dialogue on global sustainable forest issues. In addition, the Montreal Process has collaborated effectively with other C&I-based organisations such as Forests Europe and the International Tropical Timber Organization (ITTO) on addressing these issues. This report, *New Zealand's Third Country Report on the Montreal Process Criteria and Indicators* is New Zealand's contribution to the wider value proposition for the Montreal Process, including by:

- fulfilling international obligations and the expectations that arose from the United Nations Conference on Environment and Development (1992), and in particular from the Principles for Forest Management;
- participating in subsequent developments, including agreements in the United Nations Forum on Forests and progress in regional and global discussions and forest reporting under the Food and Agriculture Organization of the United Nations (FAO);
- demonstrating a national commitment to sustainable forest management for all forests;
- demonstrating the sustainability of the country's plantation forests and wider timber harvesting policies;
- building, through the collaborative approach to the Montreal Process, enduring relationships with the countries, organisations and individuals that are also interested in sustainable forest management and that can, individually and collectively, be key influencers of international forest policy;
- being an authoritative and respected participant in international forestry processes.

New Zealand's ability to report on criteria and indicators

This report includes comment on all 54 indicators. Some of these comments are comprehensive, both qualitatively and quantitatively; others are more descriptive. Where data are not available for inclusion in this report, the indicator reports endeavour to describe what information has nevertheless been collected.

The distinction between New Zealand's commercial plantation forests and its largely protected indigenous forests is a special feature of the New Zealand forest estate. This fundamental difference in the management of the forests is also reflected in the availability of data to support the Montreal Process criteria and indicators. In most instances, more detailed information is available on plantation forest than on indigenous forest. Recent national monitoring programmes and international reporting are resulting in better information for indigenous forests.

Quality of information and trends against indicators

This is New Zealand's third national report and is an assessment as at mid-2014. The quality of information used for each indicator was assessed against its availability and coverage, and expressed as high, medium or low.

Trends have been assessed against the positions described in the *2008 New Zealand report,* and for revised indicators for Criterion 7, on the basis of available information. For some indicators, quantitative data enable these assessments to be made; for others, qualitative evaluation has been required. In some instances, negative trends are associated with better information and enhanced understanding of the indicator. For all indicators, "traffic light" symbols have been used to express these trends, showing neutral (▶), positive (▲) and negative (▼) changes.

Natural forest or indigenous forest

The Montreal Process Working Group uses the term "natural forests". The New Zealand reporting uses the term "indigenous forests". The use of "indigenous" is consistent with New Zealand's Resource Management Act 1991 and Forests Act 1949. The former refers to "…indigenous vegetation" and "…indigenous fauna", while the latter uses the word "indigenous" to mean a species of flora or fauna "…that occurs naturally in New Zealand or arrived in New Zealand without human assistance" (section 2(1)).

Co-ordinating agency and contributors

The Ministry for Primary Industries (MPI) has taken responsibility for co-ordinating information gathering and for writing this report. MPI is seen as the appropriate agency as it leads government involvement in domestic and international sustainable forest management.

Other government departments that contributed to the compilation of the report were the Department of Conservation and the Ministry for the Environment. MPI acknowledges the contributions made by these organisations.

Review

A draft report was externally reviewed by the Ministry for the Environment and the Department of Conservation. However, responsibility for the contents of the final report lies with MPI.

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CRITERION 1:
CONSERVATION OF BIOLOGICAL DIVERSITY

Forests, and particularly indigenous forests, support a substantial proportion of the planet's biological diversity and terrestrial species. Biological diversity enables an ecosystem to respond to external influences, to recover after disturbances and to maintain essential ecological processes.

Human activities and natural processes can impact adversely on biological diversity by altering and fragmenting habitats, introducing invasive species, or reducing the population or ranges of species. Conserving the diversity of organisms and their habitats supports forest ecosystems and their ability to function, reproduce and remain productive.

Table 1.1 lists the indicators covered in this section.

Table 1.1: Indicators for Criterion 1 – quality of information and trends

	Criterion 1: Conservation of biological diversity	Quality of information	Trend
	Ecosystem diversity		
1.1.a	Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure	M/H	▼
1.1.b	Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage	M/H	▲
1.1.c	Fragmentation of forests	M/H	▶
	Species diversity		
1.2.a	Number of native forest-associated species	M	▶
1.2.b	Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment	M	▼
1.2.c	Status of on site and off site efforts focused on conservation of species	M/H	▲
	Genetic diversity		
1.3.a	Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes	Indig. L/M Exotic H	Indig. ▲ Exotic ▼
1.3.b	Population levels of selected representative forest-associated species to describe genetic diversity	M	▶
1.3.c	Status of on-site and off-site efforts focused on conservation of genetic diversity	L/M	▲

KEY

L = low	Neutral ▶
M = medium	Positive ▲
H = high	Negative ▼

NEW ZEALAND OVERVIEW

Key changes since 2008 are the:

- use of satellite imagery, which continues to improve resource data on the forest estate;
- development of a National Biodiversity Monitoring and Reporting Programme to assess the ecological integrity of public conservation lands;
- application of the New Zealand Threat Classification System, which indicates that 12 threatened taxa have improved in status, but the status of 59 taxa has worsened;
- new technologies for reducing and eradicating mammalian pests and preventing their reinvasion of sensitive habitats, which are creating opportunities to reintroduce endangered fauna and flora to areas they formerly occupied;
- enhancement of efforts to understand genetic diversity of iconic species.

Recent satellite-based estimates put New Zealand's total forest area[4] at 10.1 million hectares or 38 percent of the total land area. This consists of tall indigenous forest (6.8 million hectares), regenerating forest (1.2 million hectares) and exotic plantations (2.1 million hectares). Tall indigenous and regenerating forest area has declined slightly over recent decades. The area of plantation forest expanded steadily through the 1990s but has since declined slightly due to conversion to more profitable agricultural land uses, notably dairy farming. While most indigenous forests remain in public ownership, plantation forests are now largely privately owned.

Coastal Pohutakawa, Bay of Islands. Photo: Ian Platt.

Over 70 percent of tall indigenous forests are protected by legislation or covenant and managed for the protection of indigenous biodiversity by the Department of Conservation, the Queen Elizabeth II National Trust and the Ngā Whenua Rāhui Fund. The latter is a contestable government fund providing protection for indigenous ecosystems on Māori land. The area of publicly owned indigenous forest protected by legislation has increased by 3.7 percent since 2006.

Publicly owned indigenous forests typically occur in large (> 500 hectares) blocks. Conversely small indigenous forest fragments (< 10 hectares) occur mostly on private land. Recent studies on the value of small forest fragments for preserving indigenous biodiversity suggest that, to maximise the retention of indigenous biodiversity, forest fragments need to be fenced to exclude farm stock and game animals; and introduced pests such as brushtail possums, mustelids and rats need to be reduced to low levels.

New Zealand's indigenous forests are characterised by a high degree of endemism. Human settlement introduced a large number of exotic plant and animal species, many of which have had detrimental effects on the indigenous biota. While the major biodiversity losses associated with early human settlement have been stemmed, indigenous biodiversity has continued to decline over the last century. Over the last decade, the Department of Conservation has developed a National Biodiversity Monitoring and Reporting Programme to assess whether the ecological integrity of public conservation lands is being maintained.

The risk of extinction of resident native taxa is assessed on a three-yearly basis[5] by expert panels convened by the New Zealand Department of

4 Includes all land within the forest margin, irrespective of whether or not it contains trees. For plantation forests, this includes harvested areas that will be replanted.

5 The interval between assessments has recently been raised to 5 years.

Conservation. Threat rankings are based on the estimated size of the national population and predicted population trends. Since the last threat status assessment, 12 threatened taxa have improved in status as a result of successful species management, and 59 have worsened in status.

New technologies for reducing and eradicating mammalian pests and preventing their reinvasion of sensitive habitat are creating opportunities to reintroduce endangered fauna and flora to areas they formerly occupied. "Mainland Islands" use intensive multi-pest control or exclusion to reduce pest mammal populations, as well as detailed biodiversity monitoring to assess the extent to which ecological restoration goals are being achieved. Fenced sanctuaries that exclude the full range of pest mammals are often community-led forest restoration projects. Together with expanding the numbers of near-shore, pest-free island sanctuaries, they are allowing an increasing number of people to see and interact with rare and endangered flora and fauna.

The understanding of genetic variation in indigenous forest-associated species remains limited. Most studies focus on rare or endangered taxa. The most comprehensive account comes from studies of threatened avifauna. Low levels of genetic diversity are present in most threatened endemic birds, and in other plant and animal groups that have been studied. In the commercial forestry sector, the dominance of a single exotic species, radiata pine, creates biotic risks that are exacerbated when it is grown in large-scale monoculture. The ability to counter these risks through breeding programmes relies on the preservation of genetic diversity. Changes to forest ownership and institutional frameworks over recent decades may be placing some of the existing radiata pine gene pool at risk.

The Department of Conservation's National Biodiversity Monitoring and Reporting Programme provides information on the population status of selected forest-associated species or species groups (weeds, ungulates, possums, palatable tree species, birds) that are considered to influence the diversity (including genetic diversity) of forests on public conservation land. Indigenous plant species greatly outnumber exotic weeds in number and abundance in forests on conservation land, and this has not changed over recent years. Introduced ungulates and brushtail possums are widespread in forests. Both are less abundant in beech than in non-beech forests. Palatable tree species such as kāmahi, māhoe and broadleaf are regenerating across public conservation lands, although there are local sites where pest mammals are preventing their regeneration. Population size structures of these palatable indicator species have been maintained over the last decade. However, mortality rates have exceeded recruitment, so current regeneration patterns may not be maintained. Results also show that indigenous forests support at least twice as many native bird species as introduced ones, in both beech and non-beech forests.

Efforts to understand and maintain the genetic diversity of iconic species such as kiwi, tuatara and kauri have gathered pace over recent decades and are now widely supported. However, little or nothing is known about the genetic variability of most endemic species, and few are being actively managed to ensure genetic diversity is retained.

Young kauri forest, Waipoua, Northland. Photo: Ian Platt.

INDICATOR 1.1 ECOSYSTEM DIVERSITY

Maintenance of the variety and quality of forest ecosystems is necessary for the conservation of species. Without sufficient habitat size, adequate connectivity, necessary structural diversity and appropriate protection and management measures, species may decline and become vulnerable to extinction.

These indicators provide information on the areas and extent of ecosystem types, forest area under formal protection, and the effects of fragmentation.

Indicator 1.1.a Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure

Recent satellite-based estimates put the total forested area[6] of New Zealand at a little over 10 million hectares, composed of tall indigenous forest (6.8 million hectares), regenerating forest (1.2 million hectares) and plantation forest (2.1 million hectares). Tall indigenous and regenerating forest area has declined slightly (< 1 percent) over recent decades. Plantation forests expanded steadily through to the early 2000s, but have since shown a small (about 3 percent) decline as some existing plantations are converted to more profitable agricultural land uses, notably dairy farming. While most tall indigenous forests (76 percent) remain in public ownership, large areas of plantation forest have shifted from publicly listed companies to various forms of private ownership over the last decade.

Rationale

This indicator provides information on the areas and extent of forest ecosystem types, including successional stage, age class and the nature of tenure or ownership. The sustainability and stability of forest ecosystems may depend on their size and diversity. If these are not maintained, forest may become vulnerable to habitat degradation and loss. Tenures or ownership types may have a variety of management regimes associated with them – each with a different impact on biological diversity.

6 Includes all land within the forest margin, irrespective of whether or not it contains trees. For plantation forests, this includes harvested areas that will be replanted, forest roads and infrastructure.

NEW ZEALAND'S REPORT

Before human settlement, most of New Zealand below the climatic treeline was forested. The arrival of Māori, about 750 years ago, precipitated widespread forest destruction. This, combined with a second wave of forest clearance by European settlers in the 19th and 20th centuries, resulted in the loss of about three-quarters of the original forest cover.

Forest area by forest type

The most recent estimate of forest area[7] is a little over 10 million hectares, or 38 percent of New Zealand's total land area of 26.8 million hectares. This includes tall indigenous forest (6.8 million hectares), regenerating forest (1.2 million hectares) and plantation forest (2.1 million hectares) (Table 1.2). These figures are higher than previously reported, largely because they are based on a broader definition of what constitutes forest[8] than has traditionally been used by the forest industry and government agencies.

More detailed mapping of indigenous forests (Shepherd et al, 2005) based on satellite imagery from 1999–2003 highlights the dominance of beech and other broadleaved species, and the extent to which some areas of New Zealand now have little remaining indigenous forest cover (Figure 1.1A, Table 1.3).

The Land Use and Carbon Analysis System (LUCAS) analyses show that tall indigenous forest area has declined slightly (< 1 percent) over recent decades, but that it remains the predominant forest cover in New Zealand. Regenerating forest, much of which is dominated by the indigenous species mānuka and kānuka, has also shown a slight decline over the same period largely as a result of agricultural intensification or transition to other forest species. Plantation forests expanded steadily through to the 2000s, but over the last decade have declined a little (about 3 percent) as some existing plantations have been converted to more profitable agricultural land uses, notably dairy farming (Figure 1.2).

7 Produced by the Land Use and Carbon Analysis System (LUCAS) for the NZ Greenhouse Gas (GHG) inventory.

8 Woody vegetation of at least 1 hectare in extent that will exceed 30 percent canopy cover and 5 metres height at maturity. For plantation forests, the area reported is the gross forest area and includes harvested areas awaiting replanting.

Table 1.2: Forest area and percentage by forest class (2012)

	Area (000 ha)[1]	% forest area	% total land area
Tall indigenous forest	6 833	67.3	25.5
Regenerating forest	1 234	12.1	4.6
Plantation forest	2 094	20.6	7.8
TOTAL	**10 161**	**100.0**	**37.9**

Note 1: Gross area.
Source: Ministry for the Environment, 2014.

Table 1.3: Indigenous forest area and percentage by forest class (1999–2003)

Indigenous forest class	Area (000 ha)	% total indigenous forest area
Podocarp	65.2	1.0
Broadleaved	348.3	5.3
Beech	2 184.4	33.3
Podocarp-broadleaved	1 246.5	19.0
Beech/broadleaved	98.1	1.5
Podocarp-broadleaved/beech	1 831.8	27.9
Kauri	91.6	1.4
Coastal	5.2	0.1
Unspecified indigenous	501.0	7.6
Subalpine scrub	193.1	2.9
TOTAL	**6 565.2**	**100.0**

Source: Shepherd et al, 2005.

Mangroves are found around the coasts of the northern half of the North Island. There is one species *(Avicennia marina)* that forms a shrub or small tree. Estimates based on satellite imagery put the area of mangrove communities at about 28 000 hectares, increasing at a rate of about 60 hectares per annum. Most mangrove communities do not attain forest status (as per the definition). Whether this is the result of environmental constraints or human activity is not clear.

Current estimates based on grower surveys[9] put the net stocked area of plantation forest at a little over 1.7 million hectares. Radiata pine is the predominant species grown for timber in New Zealand and, together with Douglas-fir, makes up 96 percent of the total plantings (Table 1.4). Over the last decade, the area of radiata pine forest has declined by 4.7 percent (76 700 hectares), eucalypt forests have declined by 38 percent (13 400 hectares), other exotic hardwood species by 35 percent (6800 hectares) and other exotic softwoods by 13 percent (3700 hectares). Conversely the area of Douglas-fir has increased marginally (2.4 percent), and there has been a substantial (about 70 percent) increase in cypress plantings, albeit from a low base (Figure 1.3).

9 National Exotic Forest Description.

Forest area by age class

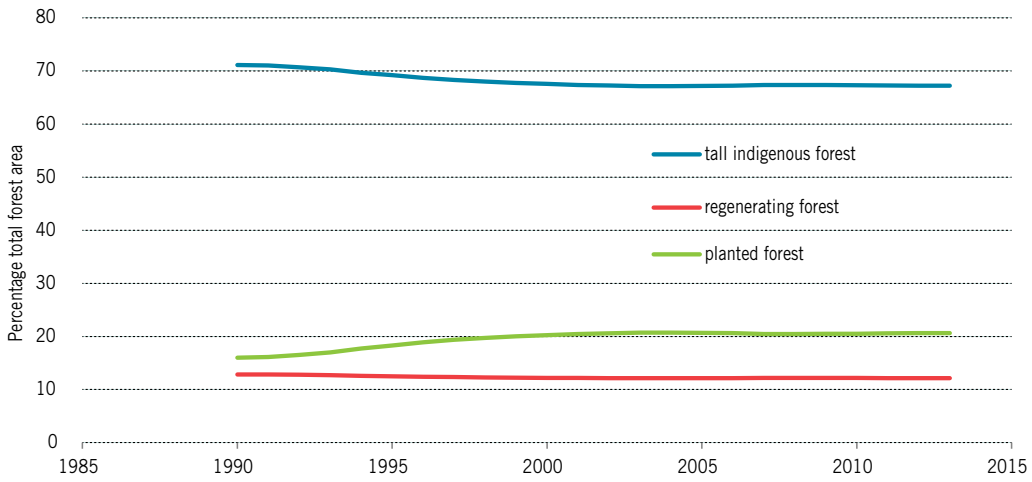
Information on forest age (Figure 1.4) is only available for plantation forests. These have an average area-weighted age of 16.8 years. Thirty percent of the plantation forest estate is aged between 16 and 20 years, and only 5.6 percent is older than 30 years.

Forest area by ownership

In 2013, 5.18 million hectares (76 percent) of New Zealand's tall indigenous forests were in public ownership and managed on behalf of the State by the Department of Conservation. The remaining 1.65 million hectares were in private (including Māori tribal) ownership.

The ownership of plantation forests over the last decade has changed substantially (Table 1.5). In

Figure 1.2: Changes to New Zealand's forest area since 1990



Source: Ministry for the Environment, 2014.

Table 1.4: Plantation forest area (net stocked) and percentage by species or species group (2013)

	Area (000 ha)[1]	% Total plantation forest area
Radiata pine	1 553.7	89.9
Douglas-fir	106.5	6.1
Cypresses	10.1	0.6
Other exotic softwoods	23.6	1.4
Eucalypts	22.0	1.3
Other exotic hardwoods	12.6	0.7
TOTAL	**1 728.5**	**100.0**

Note 1: Net stocked area. Excludes 51 900 hectares of harvested area awaiting replanting.
Source: Ministry for Primary Industries, 2014a.

particular, large areas of forest previously owned by public companies have been transferred to private ownership. Private owners include private companies, partnerships, pension funds, individuals and trusts, as well as Māori trusts and incorporations. "Central government" forests are predominantly government-owned forests on Māori leasehold land that are managed by the Ministry for Primary Industries (Crown Forestry).

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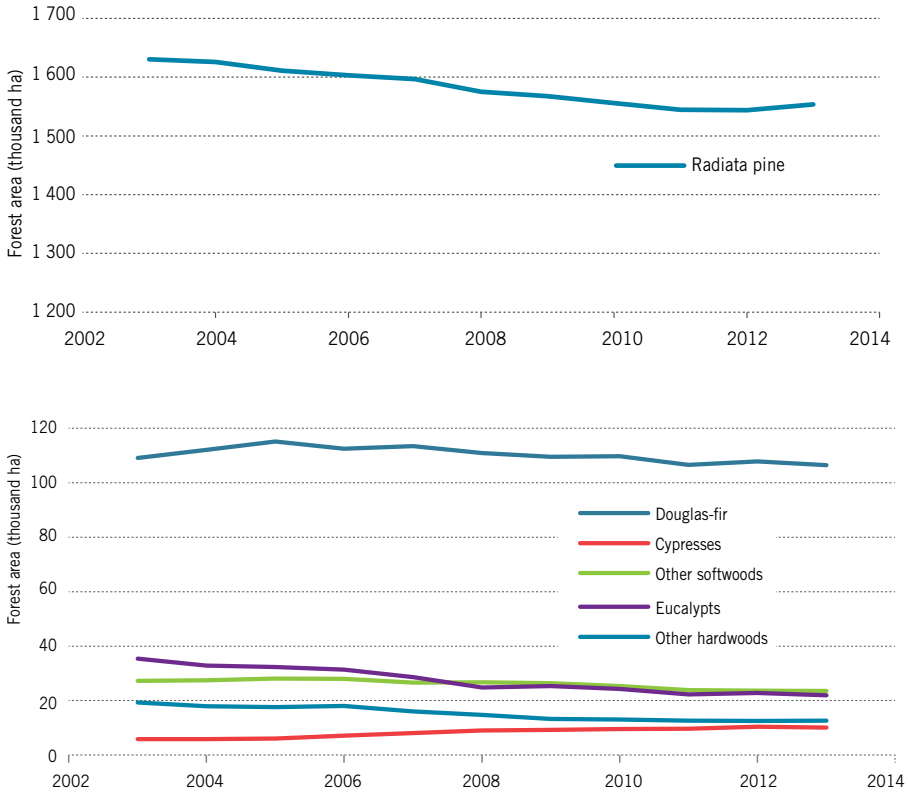
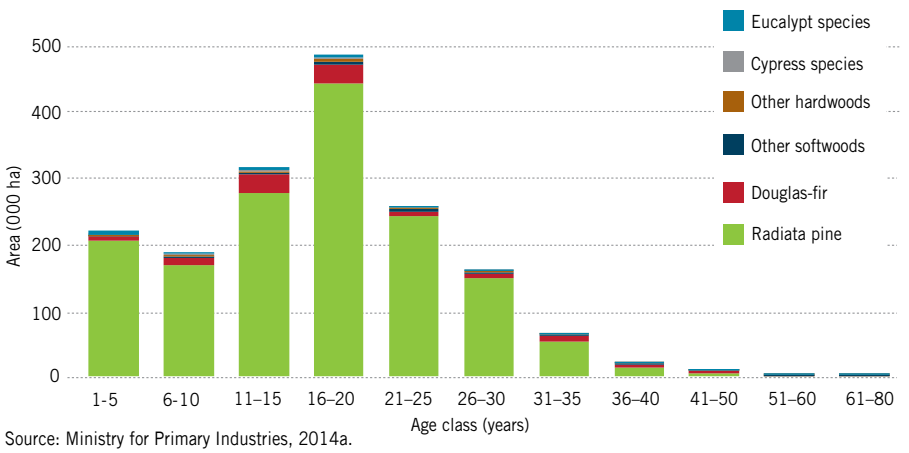
Figure 1.3: Changes to plantation forest area (net stocked) between 2003 and 2013



Sources: Ministry of Agriculture and Forestry, 2004; Ministry for Primary Industries, 2014a.

Figure 1.4: Plantation forest area (net stocked) by age class and species



Source: Ministry for Primary Industries, 2014a.

Table 1.5: Plantation forest area by ownership category (2003–2012)

Ownership category[1]	2003		2007		2012[2]	
	Area (000 ha)[3]	% of total area[4]	Area (000 ha)[3]	% of total area[4]	Area (000 ha)[3]	% of total area[4]
NZ-registered public company	829	45.4	244	13.7	16	0.9
Privately owned	852	46.6	1 421	79.4	1 591	92.5
State-owned enterprise	42	2.3	32	1.8	13	0.7
Local government	58	3.2	56	3.1	46	2.7
Central government	45	2.5	37	2.1	54	3.1
TOTAL	**1 827**	**100.0**	**1 790**	**100.0**	**1 720**	**100.0**

Notes: 1. Ownership is based solely on the ownership of the forest, irrespective of the ownership of the land.
2. The latest year for which these data are available.
3. Net stocked plantation production forest area.
4. Totals may not add due to rounding.

Sources: Ministry of Agriculture and Forestry, 2004 and 2008; Ministry for Primary Industries, 2013.

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Indicator 1.1.b Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage

In New Zealand, indigenous forests cover about 8 million hectares or 30 percent of the total land area. Over 70 percent of these forests are protected by national legislation. In the seven-year period (2006–2013) for which data are available, the area of indigenous forests in public ownership increased by 3.7 percent.

Quality of information: M/H

Progress against indicator: ▲

Rationale

This indicator provides information on the area and extent of forest by ecosystem type, age class or successional stage protected to safeguard biological diversity and representative examples of forest ecosystem types. This indicator will also help identify forest types of conservation value that are in need of protection. The level of formal protection given to forests is a reflection of the importance society places on their conservation.

NEW ZEALAND'S REPORT

Forest area in protected areas by forest type

New Zealand's protected areas are defined by national legislation. This legislation includes the Wildlife Act 1953, Reserves Act 1977, Queen Elizabeth the Second National Trust Act 1977, National Parks Act 1980, Conservation Act 1987 and the Crown Forest Assets Act 1989. The Department of Conservation is the lead government agency charged with conserving New Zealand's natural and historical heritage. Conservation is defined in the Conservation Act 1987, as:

> ... the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options for future generations (section 2(1)).

Recent estimates of New Zealand's forest cover put the total area of indigenous forest at about 8 million hectares, or 30 percent of the total land area. This is split between tall indigenous (85 percent) and regenerating (15 percent) forests. Over 70 percent of these forests are protected under legislation administered by the Department of Conservation, the Queen Elizabeth II National Trust and the Ngā Whenua Rāhui Fund (Table 1.6). The latter is a contestable Ministerial fund established in 1991 to provide funding for the protection of indigenous ecosystems on Māori land. Its scope covers the full range of natural diversity originally present in the landscape.

Table 1.6: Forest area protected to safeguard biological diversity and representative examples of forest ecosystem types

Agency providing protection	Forest type	Area (000 ha)
Department of Conservation	Tall indigenous forest	5 181
	Regenerating forest	358
	Tall indigenous plus regenerating forest	5 539
Ngā Whenua Rāhui Fund	Tall indigenous forest	116
	Regenerating forest	26
	Tall indigenous plus regenerating forest	142
Queen Elizabeth II National Trust	Indigenous forest	64
ALL AGENCIES	All indigenous forests	5 745

Sources: Department of Conservation (undated); Ngā Whenua Rāhui Fund (undated); Queen Elizabeth II National Trust (undated).

Table 1.7: IUCN classification of tall indigenous forests managed by New Zealand's Department of Conservation

IUCN category		Indigenous forest area (000 ha)		
		2006	2008	2013
Ia	Strict Nature Reserve: protected area managed mainly for science.	160	160	158
Ib	Wilderness Area: protected area managed mainly for wilderness protection.	37	37	36
II	National Park: protected area managed mainly for ecosystem protection and recreation.	1 947	1 947	1 966
III	Natural Monument: protected area managed mainly for conservation of specific natural features.	1 424	1 444	1 573
IV	Habitat/Species Management Area: protected area managed mainly for conservation through management intervention.	19	19	19
TOTAL FOREST AREA WITHIN PROTECTED AREAS		**3 587**	**3 607**	**3 752**
V	Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation.	4	4	6
VI	Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems.	n.a.	0	10
Unclassified		1 404	1 392	1 413
TOTAL FOREST AREA		**4 995**	**5 003**	**5 181**

Source: Department of Conservation, 2005.

Tall indigenous forests in public ownership (that is, those managed by the Department of Conservation) are also classified using the International Union for Conservation of Nature (IUCN) protected area categories (Table 1.7). This allows the level of legislative protection to be assessed against internationally recognised criteria. In the seven-year period (2006–2013) for which data are available, the area of publicly owned indigenous forest protected by legislation increased by 3.7 percent. The Parliamentary Commissioner for the Environment has called for conservation lands to be reclassified to better reflect their indigenous biodiversity values. If this occurs, the area estimates for some IUCN categories are likely to increase substantially.

Forest area in protected areas by age class or successional stage

New Zealand does not have the data available to report on this part of the indicator.

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Indicator 1.1.c Fragmentation of forests

The extent of fragmentation in New Zealand's indigenous forests showed little change between 2000 and 2012. Most tall indigenous forests occur in large (> 500 hectares) tracts of land that are in public ownership. Small indigenous forest fragments are mainly found on privately owned land. The value of forest fragments for preserving indigenous biodiversity has been the subject of several studies over recent decades. To maximise the retention of indigenous biodiversity in these fragments, both farm stock and introduced pests such as brushtail possums and rats need to be excluded.

Quality of information: M/H

Progress against indicator: ▶

Rationale

This indicator provides information on the extent to which forests are being fragmented over time by human activities and natural processes. Fragmentation may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health.

NEW ZEALAND'S REPORT

Forest fragmentation has been linked to the loss of indigenous biodiversity, increased establishment of invasive species, and changes to the way in which ecosystems function. Two factors stand out. The first is that, as forests become more fragmented, the ratio of forest edge to core forest area increases. Forest-edge habitats are more prone to summer drying, damage from severe winds, and invasion by fauna and flora from the adjacent non-forest communities. Many forest-associated species struggle to survive in the uncertain forest-edge environment. The second factor is the effect that the loss of continuous habitat has on the ability of species to forage, to reproduce and to disperse. Where forest fragments are sizable and in close proximity to one another, these effects may not be large. However, as the size of the fragments reduces and the distance between fragments increases, species with larger home ranges are forced to forage beyond their primary habitat and those with limited ability to disperse become isolated within their fragments and are no longer able to contribute to the wider gene pool.

The New Zealand Land Cover Database (LCDB) enables changes to the fragmentation of tall indigenous forests[10] to be assessed between 2000 and 2012 (Tables 1.8 and 1.9). The results show little change over this period. However, they show a marked difference between publicly owned indigenous forests that are managed for conservation purposes, and those in private ownership. The vast majority (about 93 percent) of indigenous forest land in public ownership is contained in tracts that are larger than 500 hectares. Away from the conservation estate, this figure drops to about 62 percent. Conversely most (about 80 percent) of small indigenous forest fragments are found on privately owned land.

10 Includes LCDB indigenous forest and broadleaved-hardwood forest classes.

Table 1.8: Number of tall indigenous forest fragments

Size of fragment (ha)	Conservation land			Non-conservation land			All forest land		
	2000	2008	2012	2000	2008	2012	2000	2008	2012
< 10	13 487	13 145	13 130	54 021	53 995	54 423	67 508	67 140	67 553
10–50	2 563	2 573	2 574	8 862	8 851	8 845	11 425	11 424	11 419
50–100	556	568	568	1 047	1 036	1 055	1 603	1 604	1 623
100–500	688	678	682	750	736	733	1 438	1 414	1 415
> 500	339	334	333	154	153	153	493	487	486
TOTAL	**17 663**	**17 299**	**17 287**	**64 834**	**64 770**	**65 209**	**82 467**	**82 069**	**82 496**

Source: Ministry for Primary Industries analysis.

Table 1.9: Percentage of tall indigenous forest area

Size of fragment (ha)	Conservation land			Non-conservation land			All forest land		
	2000	2008	2012	2000	2008	2012	2000	2008	2012
< 10	0.6	0.6	0.6	9.8	9.7	9.8	2.7	2.7	2.7
10–50	1.3	1.3	1.3	11.6	11.6	11.6	3.4	3.4	3.4
50–100	0.9	1.0	1.0	5.0	5.0	5.1	1.6	1.6	1.6
100–500	4.1	4.1	4.1	11.6	11.4	11.3	4.2	4.2	4.2
> 500	93.1	93.1	93.1	62.0	62.2	62.1	88.2	88.2	88.2
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Ministry for Primary Industries analysis.

The value of small forest fragments for preserving indigenous biota in what are nowadays often highly developed landscapes has been the focus of several studies over recent decades. A survey of isolated kahikatea (*Dacrycarpus dacrydioides*) stands on farmland in the Waikato Basin (Figure 1.5) demonstrated that, even in unfenced remnants, much of the original native flora had managed to survive (Smale, 2004; Smale et al, 2005). Fencing to exclude stock allowed a diverse native understorey to re-establish over several decades (Figure 1.6). Most adventive species within the forest fragments were pasture grasses or herbs and, within 20 years of removing grazing, these had been largely suppressed by taller native vegetation. A small group of persistent invasive weeds, notably privet, barberry, ivy and tradescantia, had the potential to hinder indigenous recovery if not adequately controlled. Remnant size did not affect the rate or success of the recovery. The best predictor was the length of time since the forest fragment had been fenced to exclude stock.

Figure 1.5: Grazed kahikatea forest fragments

In a similar study of forest fragments dominated by tawa (*Beilschmiedia tawa*) in the central Waikato, excluding stock enabled a dense thicket of native saplings to develop in the understorey within 15 years (Dodd et al, 2011; Innes, 2009; Innes et al, 2010). However, where pest herbivores, notably brushtail possums, were not also culled, regeneration of palatable canopy species such as mangeao (*Litsea calicaris*) was suppressed in favour of less palatable sub-canopy tree species. Where fragments had been fenced for 30–40 years, soil was less compacted, litter decomposition rates increased, and invertebrate densities were up to 100 times those found in unfenced fragments. The downside of these changes was a significant increase in ship rat numbers, presumably attracted by the enhanced supply of seeds, invertebrates, lizards and nesting birds. To maximise indigenous biodiversity in these forest fragments, both farm stock and pests such as brushtail possums and rats need to be excluded.

Focusing on broad species groups, however, does not tell the full story. For example, a study of beetle assemblages in Waikato kahikatea forest fragments (Harris and Burns, 2000) concluded that they had a rich indigenous beetle fauna and represented important refuges in the pastoral landscape. This contrasts with a study of ground beetles *(Coleoptera, Carabidae)* in forest fragments in a similar agricultural

Figure 1.6: Ungrazed kahikatea forest fragments

landscape in the lower North Island (Lövei and Cartellieri, 2001). Here botanically diverse and well-maintained forest fragments were found to contain few carabid species compared with a nearby large forest tract. Increased risk of predation in small forest patches and the limited dispersal ability of endemic carabids were cited as likely causes of the reduction in species richness.

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INDICATOR 1.2 SPECIES DIVERSITY

The greatest and most readily recognisable aspect of biological diversity is the variety of species and their population levels. A key objective for the conservation of biological diversity is to slow down the rate of population decline, and species depletion and extinction due to human factors. Changes in species population levels and distribution may also provide an early warning of changes in ecosystem stability and resilience, as will increases in the number of invasive, exotic forest-associated species.

Indicator 1.2.a Number of native forest-associated species

New Zealand's indigenous forests are characterised by a high degree of endemism. Human settlement introduced a large number of exotic plant and animal species, many of which have had detrimental effects on the indigenous biota. While the major biodiversity losses associated with early human settlement have been stemmed, indigenous biodiversity has continued to decline over the last century. Over the last decade, the Department of Conservation has developed a National Biodiversity Monitoring and Reporting Programme to assess whether the ecological integrity of public conservation lands is being maintained.

Rationale

This indicator provides information on the health of forest ecosystems through the number of native forest-associated species. Knowledge of the number of native forest-associated species highlights the importance of certain forest types in meeting conservation objectives and in understanding the relationships species have within ecosystems. The loss or addition of species in an ecosystem can provide valuable insights into the overall health and productivity of that system.

NEW ZEALAND'S REPORT

New Zealand is an archipelago in the southwest Pacific with a long isolation from major landmasses and a strongly endemic indigenous biota. It was one of the last places on earth to be settled by humans. Birds rather than mammals were the dominant terrestrial vertebrates, and slow-growing evergreen forests without any major influence from natural fire predominated below the climatic treeline. The arrival of first Polynesian, and later European, settlers precipitated widespread reductions in forest cover and major losses of indigenous biodiversity. Notwithstanding these effects, much of the forest landscape and species composition of New Zealand still bears a pre-human imprint.

New Zealand's remaining indigenous forests are now largely conserved from clearance or significant modification under a statutory framework that applies to forests on both private and public lands. The conservation of remaining indigenous forest remains a core objective of Government policy, with the *New Zealand Biodiversity Strategy* published in 2000. There is also a suite of private initiatives and private-public accords. While the major biodiversity losses have been stemmed, indigenous biodiversity has continued to decline.

A concerted effort has been made to provide a coherent nation-wide picture of New Zealand's biological diversity. For terrestrial groups of plants and animals, this information is updated by specialist groups, as part of the Department of Conservation's triennial assessment[11] of changes to the conservation status of indigenous taxa (Table 1.10).

This information covers all terrestrial ecosystems, not just forests. Points to note are the high levels of endemism found in most groups, and the much greater degree of taxonomic uncertainty associated

11 The interval between assessments has recently been increased to five years.

Table 1.10: Number of indigenous species, described species and introduced species

Species	Estimated number of indigenous species	Number of taxa[1] that have been described	Percentage of described species that are endemic	Number of described species known to be threatened	Number of introduced species in the wild
Mosses, liverworts and hornworts	1 184	1 122	35	45	36
Ferns and fern allies	233	210	45	12	52
Conifers	24	21	100	0	40
Flowering plants	2 912	2 193	85	223	2 453
Invertebrates	c. 40 000	c. 19 400	c. 66	255	2 246
Amphibians	4	4	100	3	3
Reptiles (terrestrial)	100	58	100	20	1
Terrestrial and freshwater birds	107	107	57	42	37
Terrestrial mammals	3	3	100	3	32

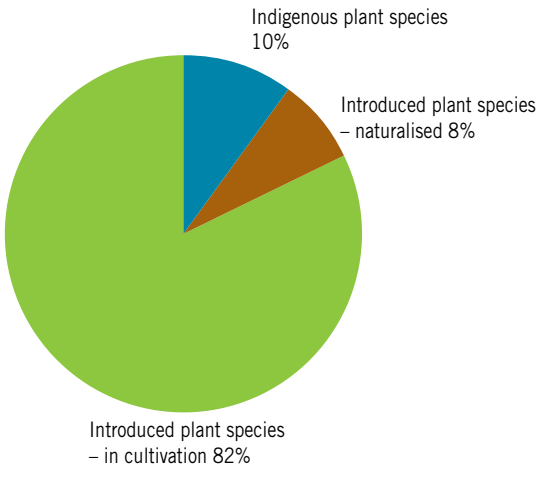
Note 1: Includes species and subspecies.
Source: Data are sourced from the New Zealand Threat Classification Series lists (2008–2011) compiled by specialist groups for the Department of Conservation.

with the invertebrates. For flowering plants it is also worth noting that, while natural ecosystems now contain an almost equal number of indigenous and introduced species, these are but a small fraction of the total number of introduced plant species present in cultivation (Figure 1.7).

Measuring and monitoring the health of indigenous forest (and non-forest) ecosystems across New Zealand continue to be a focus for New Zealand's Department of Conservation. Over the last decade, the department has developed a National Biodiversity Monitoring and Reporting Programme (NBMRP)[12] to assess whether the ecological integrity of public conservation lands is being maintained. Ecological integrity is the ability of the indigenous biota, abiotic features and natural processes to function in sustainable communities, habitats and landscapes. It encompasses all levels and components of biodiversity, and can be assessed at a local, regional or national scale. The system uses information from vegetation and animal surveys, expert-driven threat listings of ecosystems, and land tenure and management information to assess (i) the status and trend of indigenous dominance on conservation land, and (ii) the effectiveness of weed and pest management on the status of native and introduced species. The NBMRP also provides (i) an early warning of threats to native species, and (ii) a basis for prioritisation for management intervention. From an operational standpoint, the system is still in its infancy. As the temporal and spatial coverage of the monitoring data increases, our understanding of the importance of ecosystems in meeting conservation objectives, and of the relationships species have within ecosystems, is expected to improve.

The value of understanding the relationships species have within ecosystems has recently been demonstrated in what has been termed the "Battle for Our Birds". Beech species, which are a dominant component of many New Zealand indigenous forests, flower and fruit heavily in some years and not in others. Flowering and fruiting in abundance is termed masting. Mast years are triggered by above-average temperatures the previous summer and can therefore be predicted. They generally occur every

Figure 1.7: Percentage of indigenous and introduced species of flowering plants present in New Zealand



Sources: Hitchmough, 2013; Bellingham, et al, 2013.

12 Previously termed the Natural Heritage Management System.

four to six years. A heavy mast can produce about 50 million seeds (250 kilograms) per hectare. In years without mast, native bird and animal populations can tolerate the low levels of rats and stoats that are present. During a mast year, rat, mice and later stoat numbers increase dramatically, which has devastating consequences for the native species. Larger hole- or ground-nesting birds such as kiwi, kākā and whio are highly susceptible to stoat predation. Smaller species such as mohua, orange-fronted kākāriki, bellbird, riflemen and robin are sensitive to both rats and stoats, as are the two New Zealand bat species.

Increased predation associated with a beech mast in the year 2000 badly affected mohua populations throughout the South Island. On Mt Stokes in the Marlborough Sounds, the population that was being monitored was wiped out. The news is similarly bad for the orange-fronted kākāriki. In the past decade, rats and stoats have wiped out some breeding strongholds and reduced other local populations by up to 85 percent. Fewer than 400 birds now remain in three subalpine beech forest catchments in Canterbury (the Hawdon, Poulter and Hurunui).

Based on temperature records, the 2013/14 summer was predicted to be a major mast flowering season for beech. Monitoring at locations throughout the South Island confirmed very heavy seed falls in the northern South Island and southeastern Otago, and moderate seed falls in eastern Fiordland and west Otago beech forests. Data from seed monitoring sites and rat tracking tunnels were analysed to determine where the highest predator impacts would occur in spring 2014. Predators in these areas were targeted using aerially applied 1080 poison baits during the spring and summer of 2014/15. In total, predator control was applied over about one-third (700 000 hectares) of beech-dominated forests.

Mast seeding is also a breeding cue for some indigenous bird species, most notably the kākāpō, an endangered flightless parrot. Nesting in the southern South Island population of kākāpō occurs only when the podocarp species rimu (*Dacrydium cupressinum*) and pink pine (*Halocarpus biformis*) have abundant fruiting years (Harper et al, 2006).

Mountain beech forest, Southern Alps, Canterbury. Photo: Ian Platt.

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New Zealand robin.

Indicator 1.2.b Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment

The New Zealand Threat Classification System uses a nationally agreed set of criteria to assess the risk of extinction of resident native taxa. Rankings are based on the estimated size of the national population and predicted population trends. The number of populations, the number of mature individuals in the largest population, and the area occupied by the taxon are also taken into account when assessing the threat status. Since the last threat status assessment, 12 threatened taxa have improved in status as a result of successful species management, and 59 have genuinely worsened in status.

Quality of information: M

Progress against indicator: ▼

Rationale

This indicator provides information on the number and status of forest-associated species at risk or in serious decline. As a result, these species may require specific action or intervention to ensure their survival. The number of species at risk and their status is a measure of the health of forest ecosystems and their ability to support species diversity.

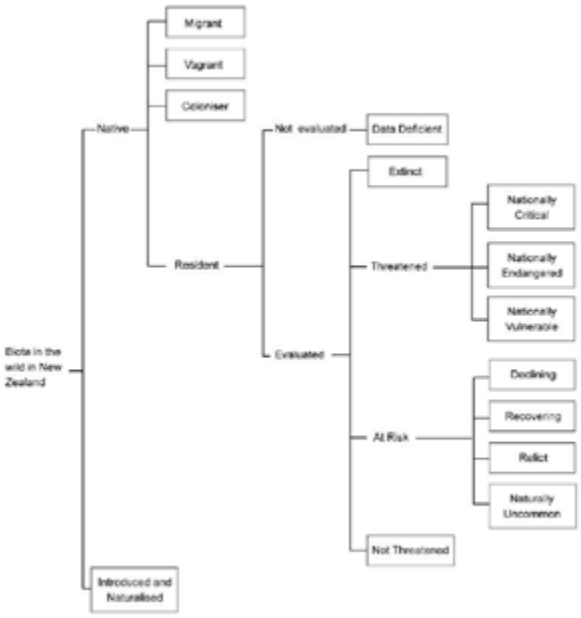
NEW ZEALAND'S REPORT

The New Zealand Threat Classification System (Townsend et al, 2008) developed by the Department of Conservation uses a set of nationally agreed categories and criteria to assess the risk of extinction for 23 groups of land, freshwater and marine organisms that are present in the New Zealand region. Assessments are revised every three years[13] by a series of expert panels, and the results published in the New Zealand Threat Classification Series (for example, Hitchmough, 2013) and other refereed publications.

The Threat Classification System uses a standardised process to allocate a threat ranking to resident native taxa (Figure 1.8). This is a qualitative process undertaken by expert panels. Rankings are based on the estimated size of the national population and ongoing or predicted population trends (Table 1.11). The total number of populations, the number of mature individuals in the largest population, and the total area occupied by the taxon are also taken into account. Taxa for which information is insufficient to determine a threat ranking are classed as data deficient.

A summary of the most recent assessment of the conservation status of New Zealand's land biota (Table 1.12) shows a high degree of knowledge of the threat status of vertebrate groups (amphibians, birds, mammals, reptiles) and vascular plants (ferns, conifers, flowering plants), but much less understanding of the lower plant (mosses, liverworts, hornworts) and the invertebrate groups that make up the bulk of the indigenous land biota. It also omits

Figure 1.8: Structure of the New Zealand Threat Classification System



Source: Townsend et al, 2008.

13 The interval between assessments has recently been increased to five years.

Table 1.11: Primary criteria for assessing threatened, at risk and not threatened taxa

Population trend	Total number of mature individuals					
	<250	250–1000	1000–5000	5000–20 000	20 000–100 000	>100 000
> 10% increase		NV/Naturally Uncommon (NU)	NU/ Relict	NU/Recovering	Not Threatened NU (Range Restricted) Relict	
Stable (± 10%)		NE/NU	NV/NU	NU/Relict		
10–30% decline		Nationally endangered (NE)	Nationally vulnerable (NV)		Declining	
30–50% decline						
50–70% decline			NE			
> 70% decline	Nationally critical (NC)					

Source: Redrawn from Townsend et al, 2008.

Table 1.12: Summary of threat rankings for land biota in the New Zealand region between 2008 and 2011

Status	Mosses, liverworts & hornworts	Ferns and fern allies	Conifers	Flowering plants	Invertebrates	Amphibians	Reptiles (terrestrial)	Terrestrial & freshwater birds	Terrestrial mammals
Nationally critical	31	9	0	146	115	1	6	10	0
Nationally endangered	10	3	0	59	58	0	3	10	0
Nationally vulnerable	4	2	0	70	68	2	8	19	1
Total threatened	**45**	**14**	**0**	**275**	**241**	**3**	**17**	**39**	**1**
Declining	1	4	0	98	45	1	27	6	1
Recovering	0	0	0	7	7	0	3	9	0
Relict	2	1	0	12	102	0	11	4	0
Naturally uncommon	122	34	3	590	924	0	10	18	0
Total at risk	**125**	**39**	**3**	**707**	**1078**	**1**	**51**	**37**	**1**
Total threatened and at risk	**170**	**53**	**3**	**982**	**1319**	**4**	**68**	**76**	**2**
Data deficient	131	1	0	76	1169	1	8	2	1
Extinct since human arrival	0	0	0	8	7	3	2	54	0
Migrant	0	0	0	0	0	0	2	2	0
Vagrant	6	1	0	11	12	0	5	50	1
Coloniser	2	0	0	17	0	0	0	4	0
Not threatened	45	155	19	1254	1803	0	22	29	0
Introduced and naturalised	36	52	40	2453	2246	3	1	37	32
Total species assessed	**390**	**262**	**62**	**4801**	**6556**	**11**	**101**	**254**	**36**
Total extant indigenous species assessed	**354**	**210**	**22**	**2340**	**4310**	**4**	**100**	**107**	**3**
Estimated number of indigenous species	**1184**	**233**	**24**	**2912**	**c. 40,000**	**4**	**100**	**107**	**3**
% of indigenous species assessed	**30**	**90**	**92**	**80**	**11**	**100**	**100**	**107**	**100**

Source: Hitchmough, 2013.

two major groupings: the fungi and the lichens. As for the species estimates in the previous section, this information covers all terrestrial ecosystems, and not just forests.

Since the previous threat status assessment (Hitchmough et al, 2007), 12 threatened taxa have genuinely improved in status as a result of successful species management, and 59 have worsened in status. The status of many more taxa has changed for better or worse as a result of improvements in our knowledge of them, changes in the interpretation of information about them, or changes to the categories and criteria following revisions to the Threat Classification System. No taxa were found to have become extinct since the previous threat status assessment, but some that are believed to have been extinct for many decades or even centuries were added to the list of extinct taxa.

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New Zealand fantail.

Indicator 1.2.c Status of on site and off site efforts focused on conservation of species diversity

New technologies for reducing and eradicating mammalian pests and preventing their reinvasion of sensitive habitat are creating opportunities to reintroduce endangered fauna and flora to areas they formerly occupied. "Mainland Islands" are being created using intensive, multi-pest control to reduce pest mammal populations, and detailed biodiversity monitoring is undertaken to assess the extent to which ecological restoration goals are being achieved. Fenced sanctuaries that exclude the full range of pest mammals are encouraging community-led forest restoration projects. Together with the expansion in the numbers of near-shore, pest-free island sanctuaries, they are allowing an increasing number of people to see and interact with rare and endangered flora and fauna.

Quality of information: M/H

Progress against indicator: ▲

Rationale

This indicator provides information that describes on site (or *in situ*) and off site (or *ex situ*) efforts to conserve species diversity. Some forest species and habitats may have declined to such an extent that intervention is required to safeguard them for the future.

NEW ZEALAND'S REPORT

The arrival of Europeans in New Zealand led to an influx of exotic plants and animals. These included a suite of mammals, most of which had few or no natural enemies in this country, that multiplied rapidly and have caused major damage to forests and forest-associated species. Deer, goats and pigs depleted forest understories and impeded regeneration. Australian brushtail possums caused widespread damage to forest canopies. By far the greatest threat to the indigenous fauna came from stoats, feral cats, rats, mice and possums, which decimated populations of vulnerable endemic species throughout the forests of mainland New Zealand. Historically, these threats have been countered to some extent by sequestering endangered species, particularly birds, on predator-free offshore islands.

The development of increasingly sophisticated technologies for reducing and eradicating mammalian pests and preventing their reinvasion of sensitive habitat, and an increasing public desire to "restore the dawn chorus" have led to a number of initiatives to reintroduce iconic indigenous fauna to areas they formerly occupied, and where the public can see and interact with them.

The Department of Conservation pioneered the concept of "Mainland Islands" in the mid-1990s. Six sites were established, covering 11 500 hectares of largely forested land, with a further 8000 hectares monitored as reference areas (Figure 1.9). While a range of ecological criteria was used to select the sites, the greatest weighting was given to the potential to recover threatened species (Saunders, 2000). At each site, intensive, multi-pest control is used to drastically reduce the density of pest mammals, and detailed biodiversity monitoring is undertaken to assess the extent to which ecological restoration goals are being achieved. A recent audit of the programme concluded that pest mammal control at Mainland Island sites has been reasonably successful, that as a result some native bird and plant species have done very well, and that some of the bird translocations have led to the establishment of new viable populations. Similar, local initiatives are now found in many parts of New Zealand.

The development of predator-proof fencing that can exclude the full range of pest mammals is encouraging an increasing number of community-led projects aimed at restoring forested habitats to their former glory. The largest of these is the Maungatautari Ecological Island Trust, which has built a 47-kilometre predator-proof fence around a 3400-hectare block of old-growth indigenous forest in the central North Island (Figure 1.10), eradicated all the pest mammals except mice within the fenced area, set up a network of tracks for people to explore this pest-

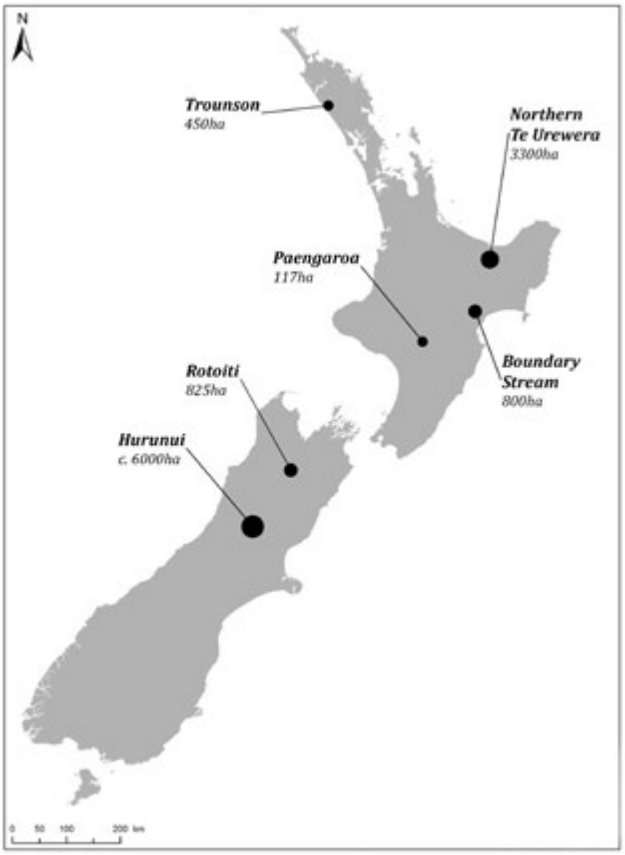
free wilderness, and begun to reintroduce threatened native species such as kiwi, kākā, takahē and tuatara. Other initiatives using predator-proof fences include the Karori Wildlife Sanctuary, which occupies a former water supply catchment in Wellington City, and the Orokonui Ecosanctuary just north of Dunedin.

The other notable effort to conserve species diversity is the restoration of near-shore islands that the public are able to visit. The long-standing example is Kapiti Island (1965 hectares) which lies about 5 kilometres off the west coast of the southern North Island. This was established as a nature reserve in 1897. Goats were eradicated from the island in 1928, followed by cats, deer, sheep, cattle, pigs and dogs. Possums were eradicated between 1980 and 1986 in the first-ever successful operation of its kind. The last of the mammalian pests, kiore and Norway rats, were finally eradicated in 1996 using an aerially applied anticoagulant poison. Kapiti Island is now home to a number of rare and endangered bird species, including little spotted kiwi, stitchbird or hihi, kōkako, takahē, brown teal, kākā and saddleback. Public access is carefully controlled by the Department of Conservation to minimise the opportunity for pests to reinvade.

The other high-profile example of a near-shore island sanctuary is Tiritiri Matangi Island, a 220-hectare scientific reserve in the Hauraki Gulf, 28 kilometres north of Auckland City. Tiritiri Matangi is now managed by the Department of Conservation, assisted by volunteers and a community group, the Supporters of Tiritiri Matangi. The island was set aside as a reserve in the mid 1970s. Restoration of the indigenous plant communities began in the mid 1980s, and since that time 15 new fauna species have been re-established there: 11 bird, 3 reptile and 1 invertebrate species. Some of these species have now reached population levels that can sustain "harvest" for translocation to other restoration projects. The island has also been used as a research site by tertiary education institutions, with over 70 postgraduate research projects completed to date (Galbraith and Cooper, 2013).

The ability to eradicate pest mammals from island sanctuaries has also been applied to a number of offshore islands in the New Zealand region and elsewhere. The largest of these, Campbell Island, was successfully rid of Norway rats during the winter of 2001. Rats had been present since before 1840 and had successfully eliminated all native land birds and most of the smaller seabirds from the 113-square-kilometre main island. In just under a month, 120 tonnes of cereal bait containing the anticoagulant toxin brodifacoum were spread across the island by four helicopters. In 2005, after several checks including using specially trained dogs, Campbell Island was declared rat free. The removal of rats from the main island allowed the reintroduction of the Campbell Island teal, which had previously been restricted to nearby rat-free Dent Island.

Figure 1.9: Location of Mainland Island sites established by the Department of Conservation



Source: Ministry for Primary Industries.

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Figure 1.10: Maungatautari Ecological Island Trust fence. Photo: Ian Payton.

INDICATOR 1.3 GENETIC DIVERSITY

Genetic diversity is the variation of genes within populations and species. As the ultimate source of biological diversity at all levels, it is important for the functioning of healthy forest ecosystems. Threats to gene pools come from climate change, catastrophic events, and human activities and pressures.

Loss of genetic variation reduces the ability of species to adapt to environmental change; and for society to maximise the potential benefits available from forest species – for example, for medicines and other bio-resources. High levels of genetic diversity within populations are usually a measure of their greater potential for survival. The loss of genetic variation within species also results in forest ecosystems that are less resilient to change.

Indicator 1.3.a Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes

Understanding of genetic variation in indigenous forest-associated species remains limited. Most studies focus on rare or endangered taxa. The most comprehensive account comes from studies of threatened avifauna. Low levels of genetic diversity are present in most threatened endemic birds, and in other plant and animal groups that have been studied. The dominance of a single exotic plantation species, radiata pine, creates biotic risks, which are exacerbated when it is grown in large-scale monoculture. The ability to counter these risks through breeding programmes relies on the preservation of genetic diversity. Changes to forest ownership and institutional frameworks over recent decades may be placing some of the existing radiata pine gene pool at risk. Similar issues surround other plantation species, notably Douglas-fir, the eucalypts and the cypresses. Most exotic non-tree forest-associated species are not at risk in this way.

Quality of information:

Progress against indicator:

Rationale

This indicator provides information on the number and distribution of forest-associated species at risk of losing genetic variation across their population. This erosion in genetic variation makes species less able to adapt to environmental change and more vulnerable to extinction. Some local populations with unique gene pools may also risk being swamped by larger populations introduced intentionally, by accident, or by natural processes.

NEW ZEALAND'S REPORT

Indigenous species

Understanding of genetic variation within and between populations of indigenous species is still in its infancy. Based on the handful of botanical studies that have been done, low genetic diversity appears to be a feature of New Zealand's indigenous tree species. This is thought to result from bottlenecks associated with repeated glaciations during the Pleistocene.

Most studies of genetic variability in indigenous species have focused on rare or endangered taxa, with the aim of ensuring that conservation efforts target the full range of genetic diversity. Examples include the endemic root parasite *Dactylanthus taylorii*, which typically occurs in small, isolated populations and is threatened by possums and rats that browse the inflorescences (Ecroyd, 1996). Genetic analysis across the species range identified four populations as the most genetically distinct at the national level, and recommended that these be targeted for management (Faville et al, 2000). More recently the genetic variability of all known populations of the endangered tree daisy *Olearia gardneri* was assessed to determine the most appropriate conservation measures for this species. Despite considerable emphasis on "eco-

sourcing" in plant recovery programmes, the study concluded that this might not be the best strategy for *O. gardneri*, due to its breeding system and population size (Barnaud and Houliston, 2010).

By far the most comprehensive account of genetic variation in indigenous species comes from studies of New Zealand's threatened avifauna (Jamieson, 2009). Historically, populations of endemic birds have declined as a result of hunting and habitat loss (Worthy and Holdaway, 2002), and continue to decline as a result of introduced predators. Low genetic diversity is a feature of most of New Zealand's threatened endemic birds, with small island populations typically containing less diversity than their larger mainland counterparts (Boessenkool et al, 2007).

Low levels of genetic diversity in historical and recent specimens of the takahē *(Porphyrio hochstetteri),* a large flightless rail, suggest a dramatic population decline in the period before European settlement, and provide molecular support for the hypothesis that the species was hunted to extinction over most of its range by early Māori (Grueber and Jamieson, 2011).

This contrasts with the kākāpō *(Strigops habroptilus),* a large flightless nocturnal parrot, which was still relatively common in southern New Zealand at the time of European settlement but which is now critically endangered. Here the mainland population, which had higher levels of genetic variation, has been driven to near extinction by introduced predators, while the island population, which exhibits very low levels of genetic variability, is being intensively managed to try to ensure the survival of the species (Robertson, 2006).

The takahē.

Similar reductions in genetic diversity have been demonstrated for species such as the saddleback *(Philesturnus carunculatus),* mohua *(Mohoua ochrocephala)* and kōkako *(Callaeas cinerea),* all of which are threatened by mammalian predation (Innes et al, 2010). However, not all of the endemic avifauna follow this pattern. A recent study of genetic diversity in the stitchbird or hihi *(Notiomystis cincta),* an endangered honeyeater, found the sole remaining island population retained high levels of genetic diversity relative to other New Zealand avifauna with similar histories of decline (Brekke et al, 2011).

The challenge for conservation managers is to balance the short-term risks to threatened species, which for the fauna tend to be predator-related, against the longer-term requirement to maintain genetic diversity in order to maximise the ability of species to respond to future challenges (Jamieson et al, 2008).

Exotic species

The commercial forestry sector in New Zealand is based almost entirely on exotic plantations that are dominated by a single species, radiata pine. In its natural range, this species is restricted to five discrete populations: three in coastal California and two on small islands off the coast of Mexico. Since the early 1950s, radiata pine has been the subject of a large and intensive breeding programme (Burdon et al, 2008; Dungey et al, 2009), which has provided substantial genetic gains and received strong uptake from the New Zealand forest industry (Burdon, 2010).

The dominance of a single exotic species creates biotic risks, which are exacerbated when that species is grown in large-scale monoculture. The risks take two main forms. The first is that pests or diseases that may or may not be present in the native environment become established and run rampant. The second occurs when species are grown outside the climatic or edaphic range of their native environment. For radiata pine, which comes from a winter-rainfall environment but which is grown on summer-moist sites in New Zealand, this increased risk is from fungal diseases such as the foliar pathogen *Dothistroma septosporum*, which first infected New Zealand plantations in the early to mid-1960s.

During the 1980s, forest industry and research organisations established the Radiata Pine Breeding Cooperative to manage the tree breeding and own the genetic resources of radiata pine (Burdon, 2008). This was superseded in 2000 by the Radiata Pine Breeding Company, which now owns and manages the genetic resource, including that of the original landrace populations that underpin the main, elite and production populations used by today's forest industry.

The large-scale shift of plantation forests from public to private ownership since the 1980s has resulted in a loss of institutional knowledge of stands covenanted to protect genetic resources, and created incentives to prioritise short-term financial returns over issues concerned with the longer-term security of the industry. The change from forestry to more profitable agricultural land uses, notably dairy farming, has also been responsible for the loss of some covenanted stands.

For researchers, the shift from bulk funding to a more contestable model, in which funding outcomes are heavily influenced by the forest industry, has constrained their ability to investigate issues that are not seen as immediate priorities by the industry. On the regulatory front, continued strengthening of biosecurity requirements is making it more difficult to import new or replacement genetic material. Despite these concerns, the general view in the forest industry is that, with radiata pine now entering its fourth generation of breeding, there remains more than enough genetic diversity for new selections against disease (J Butcher, personal communication, 2014). Similar issues surround other plantation species, notably Douglas-fir, the eucalypts and the cypresses (Dungey et al, 2012a, 2012b). Most non-tree exotic forest-associated species are not at risk in this way.

New Zealand kea.

The challenge for both government regulators and industry representatives is to balance the requirement for industry profitability against the need to maintain the genetic diversity of the key forestry species in order to maximise the ability of researchers to respond to future challenges.

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Indicator 1.3.b Population levels of selected representative forest-associated species to describe genetic diversity

The National Biodiversity Monitoring and Reporting Programme (NBMRP), recently implemented by the Department of Conservation, is providing improved information on the population status of selected forest-associated species or species groups (weeds, ungulates, possums, palatable tree species, birds) that are considered to influence the diversity (including genetic diversity) of forests on public conservation land. Indigenous plant species greatly outnumber exotic weeds in number and abundance in forests on conservation land, and this has not changed over recent years. Introduced ungulates and brushtail possums are widespread in forests. Both are less abundant in beech than in non-beech forests. Palatable tree species such as kāmahi, māhoe and broadleaf continue to regenerate across public conservation land, although there are local sites where pest mammals are preventing their regeneration. While the population size structures of these palatable tree species have been maintained over the last decade, mortality rates have exceeded the rate of recruitment, so current regeneration patterns may not be maintained. Results also show that indigenous forests support at least twice as many native bird species as introduced ones, in both beech and non-beech forests.

Rationale

This indicator provides information on the population status of selected forest-associated species that are considered to reflect the genetic diversity present in forest ecosystems. Some forest species support or rely heavily on particular forest structures, patterns, associations and processes and can therefore be used to describe the status of genetic diversity in forests as a whole.

NEW ZEALAND'S REPORT

Most indigenous forest species occupy a small proportion of their former range, owing to the large-scale forest clearance in New Zealand following first Polynesian and later European settlement. The main exceptions to this are the beech forests in the South Island, which still occur over a large part of their pre-settlement range.

The Department of Conservation's recently implemented National Biodiversity Monitoring and Reporting Programme (see Indicator 1.2.a) provides information on the population status of selected forest-associated species or species groups (weeds, ungulates, possums, palatable tree species, birds) that are considered to influence the diversity (including genetic diversity) of forests on public conservation land. Data are obtained from a nationally representative set of permanent plots that was established in 2002–2007 and re-measured in 2009–2014 (Allen et al, 2009; Payton et al, 2004).[14] Results from a partial re-measurement of the plot network provide the first national-scale assessment of the trends in the diversity of New Zealand's indigenous forest ecosystems (MacLeod et al, 2012).

Trends in the population status of the influential introduced species (see also discussion on these species as invasives under Indicator 3.a), as assessed from results across the NBMRP plot network, show the following:

- **Indigenous plant species greatly outnumber exotic weeds** in forests on public conservation land. Although weeds are widespread, most occur at low frequency. The number and abundance of weed species did not change significantly between measurements. Forests in national parks had fewer weed species than those on other types of public conservation land. Plots closer to grasslands or settlements had a higher percentage and number of weed species than those further away (Table 1.13).
- **Introduced ungulate (deer, goats) populations** – a serious threat to indigenous species diversity because they can substantially alter the structure and composition of forests, and have no natural

14 These plots were initially established to estimate biomass carbon stocks for New Zealand's greenhouse gas inventory.

Table 1.13: Number and frequency of weed species on indigenous forest plots

	2002–2003	2009–2012
Number of indigenous species	704	731
Number of weed species	122	127
Percentage of plots with weeds	40.5	32.6
Mean number of weed species per plot	1.7 (± 0.5)	1.5 (± 0.4)
Mean percentage of weed species per plot	3.4 (± 0.9)	3.1 (± 0.9)

(*n* = 328)

Source: MacLeod et al, 2012.

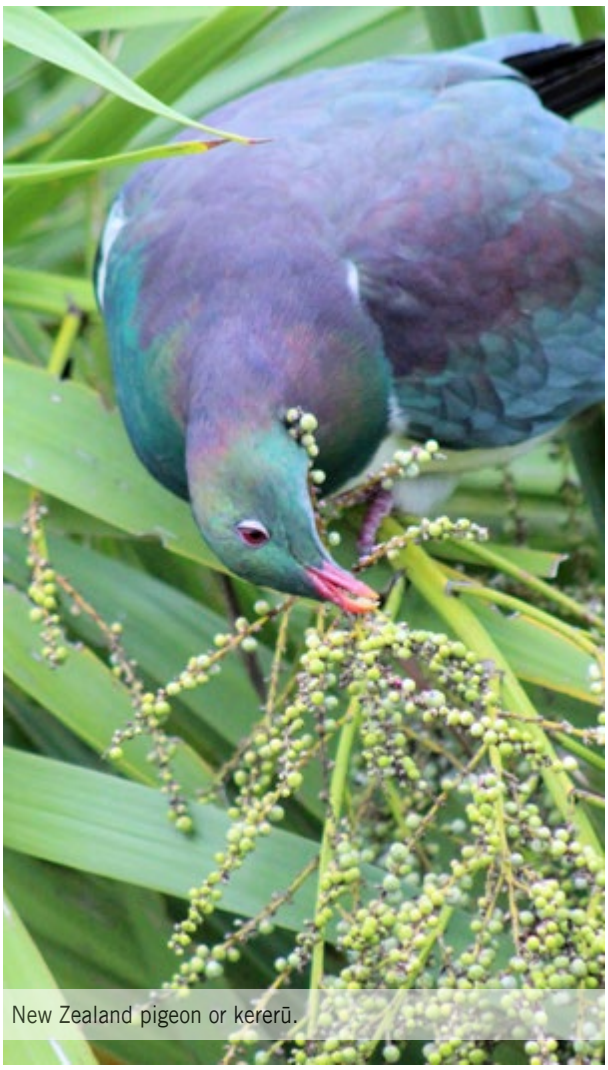
predators – were mostly at low abundances compared with those observed from the 1950s to 1970s (Forsyth et al, 2011). This is likely to be due to the sustained effects of commercial and recreational hunting and Department of Conservation control measures. In the most recent measurement[15] of the NBMRP plot network, ungulates were present at 75 percent of the sampling locations.

- **Australian brushtail possums** – originally introduced to establish a fur trade, and primarily arboreal browsers – were present at 80 percent of forest sampling locations on the NBMRP plot network. As with ungulates, possums have strong preferences for broadleaved tree species, and have little impact on beech or podocarp canopies (Payton, 2000).

The NBMRP also measures changes in the indigenous species affected by introduced species. Kāmahi (*Weinmannia racemosa*) is an important indicator in this regard. It is used to assess the status and trend of palatable tree species because it forms forest canopies throughout much of New Zealand and is highly palatable to both ungulates and possums. Death of adult trees in this species has been attributed to possums (Rogers and Leathwick, 1997) and failure of regeneration to ungulates (Payton et al, 1984). At a national scale, the size class structure of kāmahi in New Zealand forests did not change between 2002–2007 and 2009–2012, and this pattern was consistent between beech and non-beech forests. However, for kāmahi and other palatable tree species such as māhoe and broadleaf, mortality rates have exceeded recruitment over the last decade, so current regeneration patterns may not be maintained (Bellingham et al, 2014).

15 Data for animal (ungulate, possum, bird) populations were not recorded during the initial measurement of the NBMRP plot network.

Results from the assessment of forest bird community composition show that indigenous forests support at least twice as many native bird species as introduced ones. This pattern is consistent across forest types (beech versus non-beech) and does not differ between national park and other conservation land. Encouragingly, the most abundant and widespread species in indigenous forests include some of New Zealand's main avian pollinators and seed



New Zealand pigeon or kererū.

dispersers (bellbird, tūī, silvereye) and cavity nesting birds such as tomtits, riflemen and kākāriki, which are susceptible to mammalian predation. Of concern is the relatively low occupancy estimates for kererū (about 35 percent), New Zealand's primary large-seed disperser, and mohua or yellowhead (about 5 percent), a cavity nesting species known to be highly susceptible to mammal (rat, stoat) predation.

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Australian brushtail possum.

Indicator 1.3.c Status of on site and off site efforts focused on conservation of genetic diversity

Efforts to understand and maintain the genetic diversity of iconic species such as kiwi, tuatara and kauri have gathered pace over recent decades and are now widely supported. However, little or nothing is known about the genetic variability of most endemic species, and few are being actively managed to ensure genetic diversity is retained.

Quality of information: L/M

Progress against indicator: ▲

Rationale

This indicator provides information that describes on site (or *in situ*) and off site (or *ex situ*) efforts to conserve genetic diversity within species. Some species have suffered from a loss of genetic variability due to population decline and a reduction in their former range and distribution. Continued loss of genetic variability will threaten the viability of these species and may accelerate a decline that may lead ultimately to extinction.

NEW ZEALAND'S REPORT

The Department of Conservation is the central government agency charged with protecting New Zealand's indigenous flora and fauna. Strategies for conserving individual species or species groups are published in Threatened Species Recovery Plans. These specify the steps that need to be taken to prevent extinction and return the species to a non-threatened state. Recovery plans are primarily used by departmental staff to allocate resources and guide work programmes. They also provide a framework for initiatives with tangata whenua, community interest groups, landowners, researchers and members of the public. The following examples provide a glimpse of efforts to conserve the genetic diversity of several iconic New Zealand species.

Kiwi (*Apteryx* spp.) are nocturnal forest dwellers. Until recent decades, their decline went largely unnoticed. The current recovery plan (2008–2018), which is the third since 1991, covers all five formally described species and the recognised variations within these. Since 1991 the conservation focus has shifted from research (first plan) and raising public awareness (second plan), to increasing management efforts to halt the decline in genetic diversity in each of the taxa (third plan). Funding for kiwi protection from public and private sources, including corporate sponsorship, has increased significantly over recent years. Despite this, much remains to be done. Populations of the three most abundant species are either confirmed (brown kiwi, *A. mantelli*) or assumed (great spotted kiwi, *A. haastii*; tokoeka, *A. australis*) to be still be in overall decline. Although declines of the critically endangered rowi (*A. rowi*) and Haast tokoeka have been arrested, their low numbers mean they remain vulnerable. Little spotted kiwi (*A. owenii*) are extinct on the mainland, but are increasing in numbers on several offshore islands and in predator-free sanctuaries on the mainland.

Today about 70 community groups actively protect kiwi over a combined area of 50 000 hectares, and Department of Conservation recovery programmes protect another 70 000 hectares of kiwi habitat. In addition to predator control, kiwi eggs from populations of the most critically endangered taxa are harvested from the wild, and the chicks reared in predator-free surroundings. When large enough to fend off predators, the birds are returned to their original habitat. Despite the ongoing decline of some taxa, there are positive signs: there is strong public awareness of and engagement with the plight of the kiwi; the research programme has provided a sound basis for their management; and population trends are generally positive where effective conservation management is being applied.

The tuatara (*Sphenodon punctatus*) is the sole survivor of an order of reptiles that flourished during the age of the dinosaurs, some 200 million years ago. Before humans arrived, it was found throughout mainland New Zealand, but today survives only on a small number of offshore islands. During the past 100

years, tuatara populations have become extinct on 10 of these islands. There is good evidence to link the decline of tuatara with the presence of rats. On islands where rats are present, tuatara numbers are low and there are few if any juveniles in the population. In addition to preying on eggs and juvenile tuatara, rats compete for the invertebrates, lizards and nesting seabirds on which tuatara feed. Researchers have developed captive breeding techniques and identified the role of temperature in determining the sex of hatchlings. Populations removed from islands during rat eradication campaigns have been boosted using these techniques, and show renewed vigour when returned to their predator-free island homes. New breeding populations are also being established on predator-free islands, including some where the public are able to see and interact with the reptiles.

At the time of European settlement, kauri (*Agathis australis*) was a dominant tree species in the lowland forests of northern New Zealand. As a result of excessive timber extraction during the 19th and early 20th centuries, mature stands of the species are now largely restricted to publicly owned reserve land. Giant individual trees (for example, Tāne Mahuta, Te Matua Ngahere), some of which are over 1000 years old and exceed 4.5 metres in diameter, are accorded special status and have become major tourist attractions.

Kauri dieback was first observed on Great Barrier Island in the early 1970s (Gadgil, 1974). Symptoms included yellowing foliage, canopy thinning and occasional tree death. Affected trees frequently had lesions on the lower trunk and main roots, which bled copious quantities of resin. The causal agent is a previously unknown species of *Phytophthora*, currently referred to as *Phytophthora* taxon Agathis or PTA. These are fungus-like microorganisms that live in the soil and are spread through the movement of soil and water. Over the last decade, surveys have identified PTA at numerous sites throughout Northland, Auckland and, most recently, the Coromandel Peninsula. This has led to concerns over the continued survival of iconic kauri trees, the loss of genetic variability within the species, and the flow-on effects for kauri-dominated ecosystems that support flora and fauna not found elsewhere.

The response of national and regional government agencies has been to establish a joint management agency team to co-ordinate efforts to limit the further spread of the disease, and to research options for

Kauri dieback, Pakiri.

treating infected or threatened trees. While it is premature to say whether efforts to contain the disease have been successful, recently published research (Horner and Hough, 2013) suggests that phosphite,[16] which is used to combat other *Phytophthora* diseases, is an effective agent against PTA.

These are but three examples of an ever-increasing number of on site and off site programmes aimed at conserving the genetic diversity of New Zealand's endemic flora and fauna. However, the positive note sounded here needs to be balanced against the realisation that little or nothing is known about the genetic variability of most endemic species, and that only a very small percentage are being actively managed to ensure genetic diversity is retained.

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16 Phosphorous acid.

Kiwi.

CRITERION 2:

MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

Many communities depend on forests directly or indirectly for a wide range of forest-based goods and services. The sustainable provision of these services is clearly linked to the productive capacity of the forest. If this capacity is exceeded, there is a risk of ecosystem decline or collapse.

For forests to be sustainable, it is necessary to understand the levels at which goods and services may be extracted or used without undermining the functioning of forest ecosystems and processes. The nature of goods and services provided by forests change over time due to social and economic trends, and technological developments. Change in the productive capacity of forests may be a signal of unsound forest management practices or other agents that are affecting forest ecosystems in some way.

Table 2.1 lists the indicators covered in this section.

Table 2.1: Indicators for Criterion 2 – quality of information and trends

Criterion 2: Maintenance of productive capacity of forest ecosystems		Quality of information	Trend
2.a	Area and percent of forest land and net area of forest land available for wood production	H	▶
2.b	Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production	M/H	▲
2.c	Area, percent and growing stock of plantations and native and exotic species	L/H	▶
2.d	Annual harvest of wood products by volume and as a percentage of net growth or sustained yield	M/H	▶
2.e	Annual harvest of non-wood forest products	L/M	▲

KEY

L = low	Neutral ▶
M = medium	Positive ▲
H = high	Negative ▼

NEW ZEALAND OVERVIEW

Key changes since 2008 are:

- a decrease of about 3 percent in the area of plantation forests available for wood production;
- an increase in the standing volume of wood in plantation forests to about 512 million cubic metres, reflecting an increase in the average age;
- the publication of a new set of regional and national wood availability forecasts;
- the ongoing development in the use of indigenous plant extracts in skincare and medicinal products.

The total forest area available for wood production is 1.9 million hectares. This is dominated by the plantation forest estate, which contributes 1.7 million hectares. These statistics have changed little over the last decade. While the area of plantation forests decreased by 3 percent between 2007 and 2013, the estimated standing volume has increased by 18 percent to 512 million cubic metres over this period – as a result of the increasing area-weighted average age.

In 2014, radiata pine accounted for 90 percent of the plantation forest estate (by area); the next most common species was Douglas-fir at 6 percent. Total harvested volume was 30.3 million cubic metres, up from 20 million cubic metres in 2007.

The area of indigenous forest available for wood production under approved plans and permits declined by 26 percent between 2007 and 2013, and currently stands at 84 000 hectares. Total harvested volumes, which fluctuated between 16 000 and 18 000 cubic metres annually between 2007 and 2012, increased to 26 000 cubic metres in 2013. Recent analysis suggests that about 250 000 hectares of privately owned indigenous forests have the potential to be sustainably managed for timber production with an annual sustainable yield of about 300 000 cubic metres, over 90 percent of which would be from beech species. Estimates of the area of indigenous plantations range from 100 to 2500 hectares. Most are small and many may not have been established for the sole purpose of producing timber.

Non-wood forest products industries are not well developed in New Zealand. On a national basis, trapping and hunting of introduced brushtail possums and deer for pelts, fibre and meat, and honey production are still the main focus. The number of animals harvested varies considerably from year to year in line with market conditions. The harvesting and exporting of sphagnum moss, which has been a significant factor in the economy of the West Coast of the South Island, has declined over recent years.

New non-wood forest product industries based on the use of indigenous plant extracts for skincare and other medicinal purposes continue to develop. Research trials and small-scale production of edible mycorrhizal fungi and ginseng are being developed in some production forests. Māori also traditionally harvest medicinal herbs.

Red, silver and mountain beech, Victoria Range, North Westland. Photo: Ian Platt.

Indicator 2.a Area and percent of forest land and net area of forest land available for wood production

The total area of forest land and the area of forest land available for wood production have decreased slightly over the last decade. This is largely the result of plantation forests being converted to more profitable agricultural land uses following harvest.

Rationale

This indicator measures the availability of forest land for wood production compared with the total forest area of a country. It provides information that will help assess the capacity of forests to produce wood to meet society's needs.

NEW ZEALAND'S REPORT

Indigenous forests

Recent analyses of satellite imagery put the area of tall indigenous forest in New Zealand at about 6.8 million hectares. A further 1.2 million hectares are classified as regenerating forest. With one exception,[17] all publicly owned indigenous forests are protected for the conservation of indigenous biodiversity. Analysis of privately owned indigenous forests (Griffiths and Wooton, 2012) indicates that about 360 000 hectares of tall forest classes contain targeted commercial species (rimu, tawa, and red and silver beech) and that in over 70 percent of this area, volumes are likely to be sufficient to support commercial harvesting. Currently about 23 percent of these forests have approved sustainable forest management plans and permits.

Privately owned indigenous forests harvested for timber are managed under the Forests Act 1949 (Part 3A, amended 1993), which specifies provisions and procedures for their sustainable management. These provisions are administered by the Ministry for Primary Industries, which approves sustainable management plans and permits and enforces compliance.

17 The exception is a 12 000-hectare block of beech forest in western Southland.

Table 2.2: Areas and percentages of forest land available for wood production (000 hectares)

	2003	2007	2013
Total plantation forest area[1]	**1 827**	**1 826**	**1 780**
Area available for wood production	1 827	1 826	1 780
Percentage available for wood production	100	100	100
Total indigenous forest area[2]	**8 080**	**8 071**	**8 067**
Area available for wood production[3]	79	113	84
Percentage available for wood production	1	1	1
Total forest area	**9 907**	**9 897**	**9 847**
Area available for wood production	1 906	1 939	1 864
Percentage available for wood production	19	20	19

Notes: 1. Net stocked forest area plus harvested areas awaiting replanting at 31 March 2003, 2007 and 2013.
2. Includes regenerating forest.
3. Area under approved sustainable forest management plans and permits at 1 April 2003, 2007 and 2014.

Sources: 1. Ministry of Agriculture and Forestry, 2004, 2008; Ministry for Primary Industries, 2013.
2. New Zealand Land Use Map 1990–2008. (Data on post 2008 indigenous forest area changes provided by the Land Use and Carbon Analysis System (LUCAS) team at the Ministry for the Environment.)
3. Ministry for Primary Industries, 2014b.

Plantation forests

Data on plantation forest areas available for wood production are based on grower surveys and reported annually in the National Exotic Forest Description. This publication records net stocked forest area, including harvested areas awaiting restocking. All plantation forests in Table 2.2 are considered to be available for wood production. Some additional areas have been planted primarily to protect highly erodible soils.

The area of plantation forest peaked at 1.84 million hectares in 2006, and since then has declined by about 3 percent.

Sources of information

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Southern rata forest, Fox Glacier, South Westland. Photo: Ian Platt.

Indicator 2.b Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production

Despite a 3 percent reduction in the area available for wood production, between 2007 and 2013 the standing volume of plantation forests has increased by 18 percent. Recent estimates suggest that the standing volume of indigenous forests has remained stable over the last decade at a little over 3200 million cubic metres. The potential for sustainable harvest of timber from privately owned indigenous forests is conservatively estimated to be 300 000 cubic metres per annum, most of which is red or silver beech.

Quality of information: M/H

Progress against indicator: ▲

Rationale

This indicator measures the growing stock and annual increment of forest area available for wood production to meet society's needs. The annual increment and growing stock can be related to the volume harvested each year to provide a means to demonstrate the sustainable management of forest resources.

NEW ZEALAND'S REPORT

Plantation forests

Despite a small reduction in the area available for wood production over the last decade, the standing volume of New Zealand's plantation forests, as estimated by the National Exotic Forest Description, has increased by an average of 9 million cubic metres per annum. The increase in standing volume is reflected in the average age of plantation forest stands, which has increased from 13.7 to 16.4 years over the same period (Table 2.3).

Total standing volume is the volume of wood contained in stems of all age classes. It includes some non-recoverable volume (commonly about 15 percent), but excludes bark.

Radiata pine (90 percent) and Douglas-fir (6 percent) are the main plantation species in New Zealand. The mean annual increments for these species over the New Zealand plantation forest estate, as estimated by the National Exotic Forest Description yield tables, are given in Table 2.4.

Table 2.3: Stem volume and stand age in plantation forests available for wood production

	2003	2007	2013
Area available for wood production[1]	1 827	1 826	1 780
Total standing volume[2]	398	434	512
Area-weighted average age[3]	13.7	14.8	16.4

Notes: 1. Net stocked forest area (000 ha) plus harvested areas awaiting replanting at 1 April 2003, 2007 and 2013.
2. Total stem volume (million m^3, under bark).
3. Age (years).

Sources: 1. Ministry of Agriculture and Forestry, 2004, 2008.
2. Ministry for Primary Industries, 2014a.

Table 2.4: Mean annual increment of total recoverable volume (cubic metres per hectare)

Stand age (years)	25	30	35	40
Radiata pine	17.6	19.2	20.0	20.2
Douglas-fir	11.8	13.1	13.9	14.8

Source: Ministry of Forestry, 1996.

Table 2.5: Mean annual increment (cubic metres per hectare) for indigenous timber species

Species	Botanical name	Mean Annual Increment (m^3/ha)
Kauri	*Agathis australis*	1–9[3]
Rimu	*Dacrydium cupressinum*	1.2–1.8[2]
Red beech	*Fuscospora*[1] *fusca*	6–10[3]
Mountain beech	*Fuscospora*[1] *cliffortioides*	5–8[3]
Silver beech	*Lophozonia*[1] *menziesii*	6–11[3]
Tawa	*Beilschmiedia tawa*	< 1[3]

Notes: 1. Formerly the genus *Nothofagus*.
2. Not specified whether total or total recoverable volume.
3. Total recoverable volume.

Sources: 1. G Stewart, 1991.
2. J Wardle, 1984.
3. P Wardle, 1991.

Indigenous forests

Current estimates suggest that, at a national scale, wood volumes in indigenous forests have remained stable over the last decade at a little over 3200 million cubic metres. Broadleaved species (notably the southern beeches) contribute 88 percent of this volume, and coniferous species (notably the podocarps) the remaining 12 percent (Beets et al, 2009). The potential for sustainable harvest of timber from indigenous forests in private ownership is conservatively estimated at about 300 000 cubic metres per annum standing volume, of which about 200 000 cubic metres would be sawlog quality. At least 90 percent of this timber is red or silver beech (Griffiths and Wooton, 2012; KPMG, 2013). Current indigenous wood removals are predominantly silver beech, with lesser amounts of red beech, hard beech and rimu.

Limited data on annual increment are available for the main indigenous timber species (Table 2.5).

Sources of information

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Indicator 2.c Area, percent, and growing stock of plantations of native and exotic species

The National Exotic Forest Description continues to provide comprehensive data on exotic plantation forests, including details on area, and growing stock by species or species groups. There is no consolidated assessment of indigenous plantation area or standing volume.

Quality of information: L/H

Progress against indicator: 

Rationale

This indicator provides information on the nature and extent of plantation forests. Changes in the area of plantation reflect society's present and future needs or the impact of competing land uses on forest cover. The use of both native and exotic plantation species may enhance the range and quantity of goods and services available.

NEW ZEALAND'S REPORT

Exotic plantations

Almost all of New Zealand's timber production comes from exotic plantation species. Radiata pine and Douglas-fir predominate, and together account for over 95 percent of the total area and the total standing volume (Table 2.6).

While the area of exotic plantations in New Zealand has declined over the last decade (see Indicator 1.1.a), the standing volumes of the two main species have continued to increase: radiata pine by 27 percent and Douglas-fir by 54 percent (Figure 2.1). These increases are a result of the maturing of the new plantings in the mid-1990s.

Indigenous plantations

Estimates of the total area of indigenous plantations range from 100 to 2500 hectares. The largest areas were established by the former New Zealand Forest Service following logging of old growth indigenous forests. They were primarily indigenous conifers (kauri, rimu and tōtara). Most of these historical plantings are on land that is now managed by the Department of Conservation, and are therefore unlikely to be harvested. Most present-day plantings are small (< 1 hectare) and have been established for a mix of purposes.

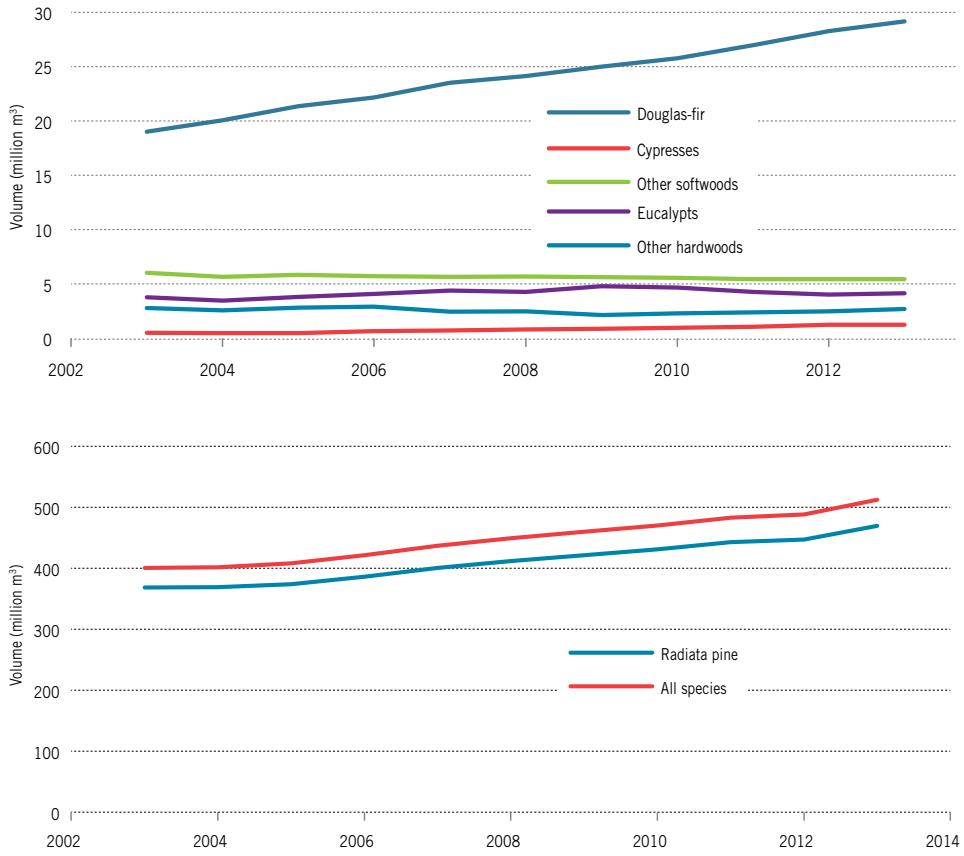
Table 2.6: Area and growing stock of exotic plantation species or species groups (as at 2013)

Species or species group	Area (ha)	Percentage of total area	Growing stock (million m³)	Percentage of total growing stock
Radiata pine	1 553 700	89.9	469.5	91.7
Douglas-fir	106 500	6.1	29.2	5.7
Cypresses[2]	10 100	0.6	1.2	0.2
Other softwoods[3]	23 600	1.4	5.4	1.1
Eucalypts[4]	22 000	1.3	4.1	0.8
Other hardwoods[5]	12 600	0.7	2.7	0.5
TOTAL	**1 728 500**[1]	**100.0**	**512.1**	**100.0**

Notes: 1. Excludes 51 900 hectares that have been harvested and await replanting.
2. *Cupressus macrocarpa, C. lusitanica*, and other *Cupressus* species.
3. Pines (other than radiata), firs (other than Douglas-fir), larches and redwood.
4. All *Eucalyptus* species.
5. Broadleaved trees including Tasmanian blackwood, walnut, oak, poplar, willow, paulownia, birch, alder and elm.

Source: Ministry for Primary Industries, 2014.

Figure 2.1: Change in the standing volume of plantation forest species or species groups between 2003 and 2013



Sources: Ministry for Primary Industries, 2012–2014, *National Exotic Forest Description*; Ministry of Agriculture and Forestry, 2003–2011, *National Exotic Forest Description*.

Sources of information

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Indicator 2.d Annual harvest of wood products by volume as a percentage of net growth or sustained yield

Current and future trends in available and harvested wood volumes are described for New Zealand's plantation and indigenous forests. For both classes of forest, the actual and forecasted harvest levels are well within the limits for sustaining the forest resource.

Quality of information: M/H

Progress against indicator:

Rationale

This indicator compares actual harvest levels against what is deemed to be sustainable. The purpose is to assess where forests are being harvested beyond their ability to renew themselves or are being under-utilised for wood products.

NEW ZEALAND'S REPORT

Plantation forests

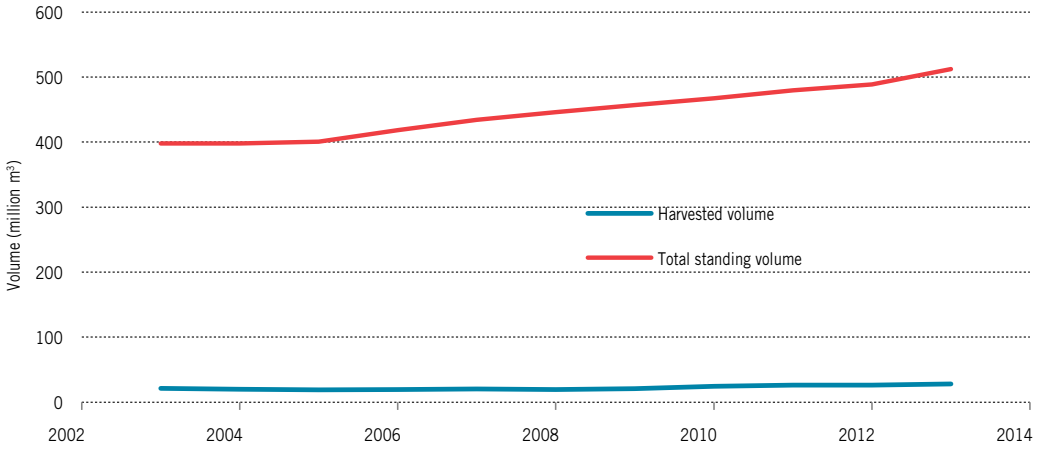
New Zealand plantations are dominated by radiata pine (90 percent) and Douglas-fir (6 percent). The volume of wood harvested annually is estimated from the quantities of processed wood products and export log volumes. Non-industrial wood removals are considered to be insignificant.

For plantation forests, most of which are now in private ownership, the annual volume of wood that can be harvested is not prescribed by any central agency. Standing volumes have increased steadily over recent years (Figure 2.2), and this growth is expected to continue as more forestry plantings reach maturity. Harvested volumes have also increased, but at a slower rate.

To assist with forest industry planning the Ministry for Primary Industries (formerly the Ministry of Agriculture and Forestry) has compiled regional wood availability forecasts for radiata pine and Douglas-fir. These were produced with the assistance of major forest growers and industry consultants. They cover the period from 2008 to 2040. Minor plantation species have not been included because of their insignificance to the overall wood supply.

The national forecasts presented here are the sum of the regional forecasts. Four scenarios are provided for radiata pine and one for Douglas-fir. The modelling uses the age class distribution of the forests (Figure 2.3) and the harvesting intentions of the large-scale forest owners (> 1000 hectares of forest) for the first

Figure 2.2: Changes in harvested and standing volumes from New Zealand plantations between 2003 and 2013



Sources: Ministry of Agriculture and Forestry, 2004–2012, *National Exotic Forest Description*; Ministry for Primary Industries 2013–2014b.

10 years to estimate an expected harvested wood volume for each year (Figure 2.4).

The following are the four scenarios applied to radiata pine:

Scenario 1 assumes all owners will harvest their forests when their forests reach the age of 30 years. This scenario shows the unconstrained availability of radiata pine from New Zealand plantations.

Scenario 2 assumes large-scale owners will harvest in line with their stated intentions, and small-scale owners will harvest their forests at age 30.

Scenario 3 assumes a non-declining yield, with a target rotation age of 30 years. Under this scenario, the potentially available volume increases to over 30 million cubic metres per year from 2020.

Scenario 4 is the same as for scenario 3 except that total wood availability is allowed to decrease from 2034 (the end of the current rotation). Wood availability increases to over 35 million cubic metres per year from 2022 before reducing to 28 million cubic metres per year from 2037.

It should be noted that while Scenarios 1 and 2 are theoretically possible, they are unlikely to be realised because New Zealand does not have the infrastructure capacity to deal with the rapid rise in wood volumes forecast for the mid 2020s.

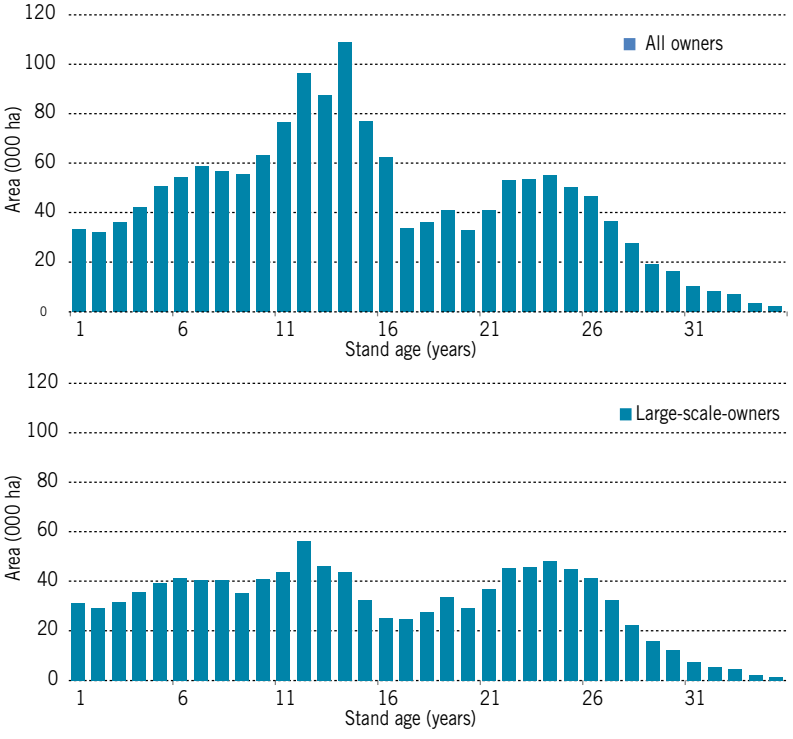
The availability of Douglas-fir wood is forecast to remain below 1 million cubic metres per annum through to 2024, and to have increased to 2.5 million cubic metres per annum by 2040.

Indigenous forests

The Forests Act 1949 was amended in 1993 to bring an end to unsustainable harvesting on private land and clearfelling of indigenous forest. Under the legislation, indigenous timber can only be produced from forests that are managed in a way that maintains continuous forest cover and ecological balance. Management systems must ensure that the forests continuously provide the full range of products and amenities, in perpetuity, while retaining the forests' natural values. Only single trees and small coupes can be felled for timber production.

Currently about 84 000 hectares of indigenous forest are approved for sustainable management for timber production, with an allowable annual harvest of 78 000 cubic metres standing volume. Actual

Figure 2.3: Age class distribution of New Zealand radiata pine plantations as at 1 April 2008



Source: Ministry of Agriculture and Forestry, 2010.

harvested volumes from 2006 to 2012 have fluctuated between 16 000 and 19 000 cubic metres (Figure 2.5). This means that actual harvest represents between 20 and 25 percent of the allowable harvest. It is likely that this difference is due to competition from imported wood products (some of which may not be from sustainably managed and legally harvested forests), and the relatively high costs of sustainable forest management. A recent legislative change that allows the salvage of wind-thrown trees from conservation land is expected to increase the volume of the indigenous timber harvest over the next few years.

Sources of information

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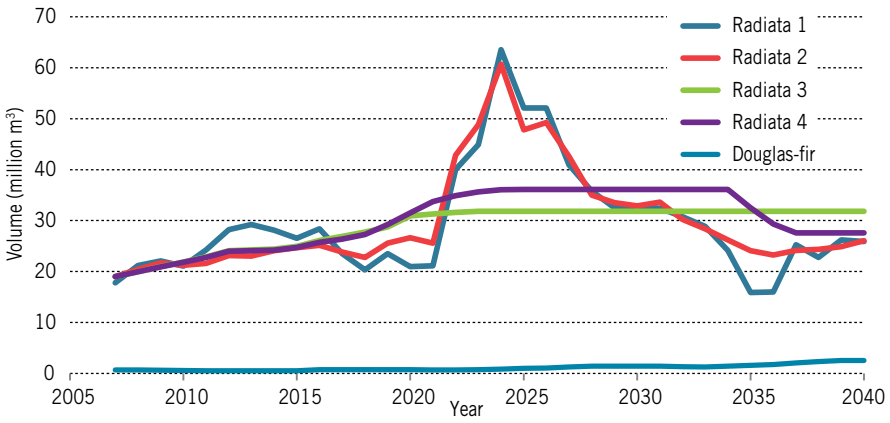
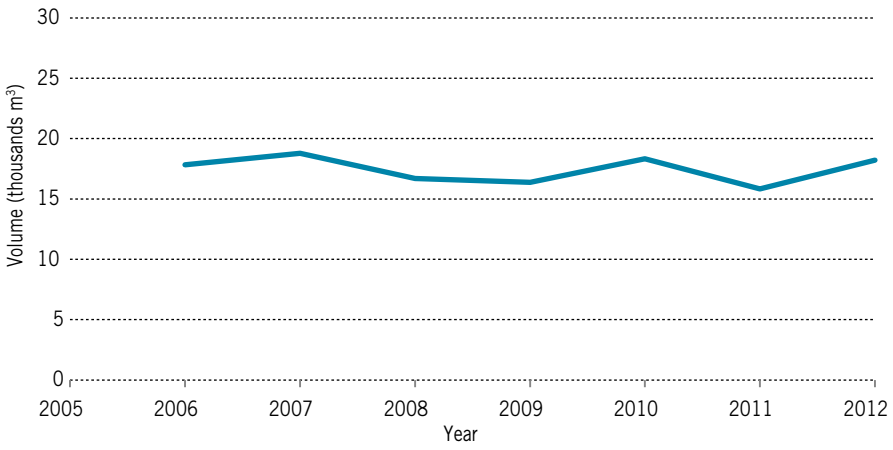
Figure 2.4: National wood availability forecasts (2008–2040) for radiata pine and Douglas-fir



Source: Ministry of Agriculture and Forestry, 2010.

Figure 2.5: Change in wood volumes harvested from New Zealand's indigenous forests between 2006 and 2012



Source: Ministry for Primary Industries, 2014a.

Indicator 2.e Annual harvest of non-wood forest products

New Zealand's forest estate supports a number of smaller industries that are unrelated to timber production. These range from beekeeping and the collection of sphagnum moss, through to game hunting and possum trapping. One of the growth areas involves the use of indigenous plant extracts in skincare and medicinal products. This activity was highlighted in the 2008 report and continues to attract commercial interest. It draws on both traditional Māori knowledge of, and research on, New Zealand's plant species. The 2003 and 2008 country reports commented on the opportunities for incorporating secondary crops (such as ginseng and edible mushrooms) into forest management systems. Work in this area continues and several commercial trials are under way.

Rationale

This indicator reports on the sustainability of the harvest of non-wood forest products. The wellbeing of indigenous and other communities dependent on non-wood forest products may be closely allied to the forest's ability to maintain its productive capacity over time.

NEW ZEALAND'S REPORT

Non-wood forest products (NWFP) are a small, but increasing, component of the forestry scene in New Zealand. The past 20 years have seen the range of products grow from game meat, honey and traditional extracts to a broader base, incorporating secondary crops and plant derivatives for skin care, health products and food ingredients. This growth has been based on research and trials by both private investors and government agencies.

The two principal activities within the NWFP sector have been beekeeping and hunting (including trapping). In 2013, 647 enterprises[18] were involved in beekeeping, hunting and trapping (Statistics New Zealand, 2015). Collectively these enterprises had an employee count of 1320 workers.[19] The majority of these enterprises were small-scale operations (that is, self-employed workers or small companies with fewer than five employees).

The number of business enterprises involved in beekeeping has grown strongly in recent years from 352 in 2000 to 502 in 2013 (Statistics New Zealand, 2015). These enterprises represent operators with a commercial number of hives.[20] A proportion of these beekeepers will rely strongly on forest and bush lands for nectar and pollen, while others will utilise these areas for part of the season and focus on pastoral land.

Enterprise numbers for hunters and trappers have been in the range of 140 to 170 over the past decade, up from 120 in 2000. These enterprises are engaged in the hunting of game meat (wild deer, goats and pigs), the management of pests, and the trapping of the Australian brushtail possum for fur and pelts. None of these animal species is native to New Zealand, and most are considered a threat to New Zealand's indigenous flora and fauna.

Medicinal extracts from indigenous plant species

A number of indigenous plant species have traditionally been used by Māori for medicinal purposes. These plants include:

- karamū – the leaves are boiled down for an extract that is good for the urinary system;
- koromiko – the leaf ends are boiled down as a tonic for dysentery and diarrhoea;
- makomako/wineberry – the leaves make a tea that is

18 An enterprise is a business or service entity, which can be a self-employed individual, a company, a partnership or a voluntary agency.

19 Employee count refers to paid employees. It is a head count of salary and wage earners sourced from taxation data.

20 Nationally there were 4279 registered beekeepers in 2013 but the majority of these owners had fewer than 5 hives, and 86 percent had fewer than 50 hives. Beekeepers with more than 350 hives are considered commercial operators.

soothing and cleansing for sore and dusty eyes;
- mānuka/tea tree – used to soothe burns (a sedative) and treat fevers and colds.

This knowledge of the health benefits of particular plant species has been passed down from generation to generation by Māori. Small quantities of these extracts continue to be collected for the private use of individuals and families. Another customary activity has been to collect berries from a number of indigenous trees and shrubs, including the kōtukutuku. The berries are harvested primarily for private use.

The medicinal properties of these indigenous plant species have attracted considerable interest over the past 20 years from the research community and health sector. A number of commercial ventures have developed around nutritional supplements, antibacterial oils and health remedies (New Zealand Trade & Enterprise, 2013). Māori have been significantly involved in these business and research initiatives, frequently drawing on customary Māori knowledge.

Plant extracts for skincare products and food ingredients

New Zealand's geographic isolation has meant that around 80 percent of all indigenous plant species are endemic, that is, they are not native to anywhere else in the world. This distinctive flora is only starting to be researched and provides opportunities to commercialise a range of new plant extracts for food ingredients and skincare products. New Zealand's "... flora produce unique flavours that can be used in the development of novel ingredients for foods and beverages with significant export potential" (Plant & Food Research, 2011, p 31).

A number of innovative businesses have been established to develop these opportunities. They draw on the increasing international demand for natural products and remedies, sourced from sustainably grown products. The companies generally have a strong export focus and their markets include Asia, the Pacific Rim, North America and Europe (New Zealand Trade & Enterprise, 2013).

The research being undertaken by public and private research agencies is focusing on both the commercialisation of new products and ways to improve the sustainable management of the forest resource. Plant & Food Research (a Crown Research Institute) is "working with Māori partners to develop new foods and ingredients based on indigenous flora and fauna, particularly traditional food plants and seafood, as well as new technologies and techniques to manage the production of native plants" (Plant & Food Research, 2011, p 30).

Honey production and related products

Honey production is one of the long-standing uses of the forest estate. Apiarists take advantage of the nectar and pollen sources available in the bush, particularly the early season nectar flow, which is critical for building up hive strength and populations. A number of New Zealand's monofloral honeys are derived from the forest estate. These include mānuka, rātā, rewarewa and tāwari. Apiarists locate their hives along the bush line or within forested areas. The national figures on the number of apiarists (and honey production) do not distinguish between those who rely predominantly on pasture or those focused on forest lands.

Nationally there were 4279 registered beekeepers in the June 2012/13 season (ranging from individuals with a single hive through to companies). Total honey production amounted to 17 825 tonnes (Ministry for Primary Industries, 2013). Production figures are weather dependent, and have varied between 9450 and 17 825 tonnes between 2008 and 2013. The average production over this six-year period was 12 526 tonnes. Production and beekeeper numbers have been increasing over the past decade. This has been driven in large part by the export market, in particular, the demand for mānuka honey. Export volumes were in a range of 2400 to 3300 tonnes between 2002 and 2005 and reached 8000 tonnes in the June 2012/13 season.

In addition to honey, apiarists produce beeswax, honey powder, honeydew, propolis (an antibiotic gum or resin) and bulk bees (principally for export).

The harvesting of honey from woodlands has the potential to affect forest ecosystems in terms of the availability of nectar and pollen for indigenous birds and insects. Limited research has been undertaken on this issue and beekeepers have been encouraged to adopt a conservative management approach when assessing stocking rates.

The Department of Conservation monitors the beekeeping concessions on public conservation land and will revoke concessions if there is evidence of

pressure on the local ecology.[21] Stocking density is naturally constrained by climatic conditions and the physical terrain.

Possum fur and skins

Commercial hunting and trapping are important management tools in controlling the possum population in New Zealand, which is estimated at 30.3 million. Without control efforts, the population has the potential to reach 48 million (Warburton et al, 2009). The major commercial products derived from possums are pelts, fibre for garments and pet food. A number of attempts have been made to establish a possum meat industry. However, areas from which the meat can be sourced are limited, owing to the presence of tuberculosis in several regional possum populations.

Harvest volumes have been erratic over recent decades, owing to fluctuations in the price for fur and pelts.[22] When fur has been out of favour as a fashion item, fewer than 500 000 possums have been commercially harvested in a season. During periods of high prices, the commercial harvest has exceeded 3 million.

After struggling in the 1980s and early 1990s with low fur and pelt prices, the fur industry has gradually re-built itself, as a result of local companies taking more control of processing and recent advances in yarn manufacturing which has allowed possum and merino fibre to be blended. Possum fibre is gaining increased attention as the "fur is 70% warmer than wool. It has superior thermal qualities because the fur is hollow inside so traps heat within its fibres" (Burlingham et al, 2008, p 3). The commercial harvest of possums (for fur and pelts) is currently in the order of 1.3 to 1.5 million per annum (Warburton, 2008). The harvest has grown as the per kilogram price of possum fibre (plucked) has more than doubled since the beginning of the last decade and is in the order of $100 to $110 per kilogram. "The use of plucked possum fur as a component in blended yarn is now well established in the New Zealand yarn industry with the total value of this industry estimated to be in the order of $50 to $70 million per annum" (Warburton, 2008, p 8).

An emerging use for possums is as a high-quality pet food (mainly for the export market). Research has shown that possum meat is high in unsaturated fatty acids, omega 3 and 6. The initiatives to date have been focused on the Bay of Plenty and East Cape.

The current level of commercial harvesting has a limited impact on possum numbers. The Department of Conservation and TBfree New Zealand (supported by the agricultural sector) undertake extensive programmes to control possum numbers.

Commercial and recreational game hunting

The game animals hunted in New Zealand include red deer, fallow deer, chamois, Himalayan tahr, wild pigs and wild goats. None of these species is native to the country. They were introduced by the early European settlers for their meat, hides and fur, and they quickly became established in New Zealand's indigenous forests.

Deer are the major game species hunted in New Zealand by recreational and commercial interests. New Zealand's feral deer population is estimated at 250 000 nationally (McKinnon, 2001). The population is spread across the conservation estate, commercial forests and upland pasture. Recreational hunters take approximately 50 000 head a year. In the 1990s and the early part of this decade, commercial deer hunters were removing 10 000 to 30 000 feral deer a year (Stringleman, 2004). Commercial deer recovery (for venison) fell sharply in 2002–2003, with a tightening of export requirements for wild venison and a decline in venison pricing. The commercial recovery of feral deer has recovered in recent years, but remains a small element of the overall venison industry.

New Zealand has developed a strong international reputation for game hunting, and a number of commercial operators now provide guided hunting tours. The Department of Conservation and the major forestry companies operate concession systems for commercial hunting operations and they issue hunting permits for private individuals.[23] A number of game estates have also been established, mainly to cater

21 The Department of Conservation has produced national guidelines for the location of beehives on public conservation land. The guidelines recognise honey production and the wintering over of hives as being generally compatible with conservation land values.

22 The market for pelts has until recently been dependent on overseas fashion trends and the requirements of fashion houses.

23 The concession and permit system is used to monitor the number of hunters and to control access to blocks where visitor numbers are high or where forestry operations are under way.

for overseas trophy hunters. These estates normally include substantial areas of bush and forest lands.

Generally no restrictions on the number of deer that can be taken apply, except "for popular herds such as Fiordland wapiti and Blue Mountains fallow deer, where systems of ballots and bag limits are in place" (Department of Conservation, 2001, Policy Statement on Deer Control, Section 4). The Department of Conservation periodically monitors deer populations and has generally found that the numbers removed by commercial and recreational hunters are insufficient to reduce feral deer densities to levels that protect ecosystems from damage.[24] The Department supplements commercial and recreational hunting with additional control measures.

Sphagnum moss collection

A regionally important non-wood forest product is sphagnum moss, principally the variety *Sphagnum cristatum*. The moss is collected primarily from swamp areas in the forests and bush lands of the West Coast of the South Island. Harvested areas normally return to a stable condition after three to five years. The harvest is mainly exported to Japan and Southeast Asia. The annual value of exports during the 1990s ranged from $13 million to $18 million, and has since fallen back to $4.0 to 4.5 million in 2011–2013 (Plant & Food Research, 2013).

New Zealand exporters target the premium orchid market, which requires long strands from mature sphagnum plants. The Department of Conservation now manages the majority of the sphagnum moss collection sites and monitors the concessions for their environmental impact.

New opportunities for non-wood forest products

Research trials on the potential for incorporating secondary crops into the plantation estate have been under way for some years. The emphasis has been on edible mycorrhizal mushrooms[25] and crops such as ginseng. The intention is to incorporate these crops into the normal plantation management regimes for exotic species.[26] The crops under investigation are high-value, low-volume commodities, which could significantly increase the viability of plantation forestry. The advantage of growing these crops in New Zealand is that forest owners can supply the traditional off-season in the northern hemisphere. A number of commercial trials and small-scale production blocks have been established.

24 Even at low densities, deer can prevent the regeneration of key native plant species.

25 Mycorrhizal mushrooms are those that live in a symbiotic relationship on and in the roots of suitable host plants.

26 In the case of high-value mycorrhizal mushrooms, such as Périgord black truffle, the returns would justify setting up dedicated plantations for their production (that is, a truffière), rather than incorporating them into the normal plantation system.

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CRITERION 3:
MAINTENANCE OF FOREST ECOSYSTEM HEALTH AND VITALITY

The maintenance of forest health and vitality is dependent upon the ability of the ecosystem's functions and processes to recover from or adapt to disturbances. While many disturbance and stress events are natural components of forest ecosystems, some may overwhelm ecosystem functions, fundamentally altering their patterns and processes and reducing ecological function.

Decline in forest ecosystem health and vitality may have significant economic and ecological consequences for society, including a loss of forest benefits and the degradation of environmental quality.

Information gained on the impacts of biotic and abiotic processes and agents may inform management strategies to minimise and mitigate risk. The maintenance of forest ecosystem health and vitality is the foundation of sustainable forest management.

Table 3.1 lists the indicators covered in this section.

Table 3.1: Indicators for Criterion 3 – quality of information and trends

Criterion 3: Maintenance of forest ecosystem health and vitality		Quality of information	Trend
3.a	Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions	M/H	▲
3.b	Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions	M	▶

KEY

L = low		Neutral	▶
M = medium		Positive	▲
H = high		Negative	▼

NEW ZEALAND OVERVIEW

Key points are that:

- surveillance, reporting and research are directed to a range of pest and weed problems, covering both planted and indigenous forests and also urban areas;
- surveillance targets high-risk sites such as areas around ports, parks and tourist regions;
- the needle cast and needle blight diseases that affect commercial planted forests are prominent threats; but drier climatic conditions and more efficient treatments have reduced the impacts of some pathogens;
- a range of other diseases affect a range of plantation forest species, including eucalypts, cypresses and Douglas-fir;
- a focus is on limiting spread and finding effective treatment of the kauri forest dieback pathogen *Phytophthora* taxon Agathis;
- possums, ungulate and other vertebrate pests seriously affect indigenous forests and associated habitats, and efforts to monitor and control these pests are continuing;
- efforts are under way to survey and manage the spread of wilding conifers displacing low stature vegetation areas in both the North and South Islands;

- storms, especially wind, fires and fire risk, affect all forests, especially planted forest.

New Zealand planted forests continue to be relatively free of serious or widespread pests and diseases that could affect management and commercial value. However, the risk of pest, weed and disease incursions from established populations in other countries remains; especially from expanding trade and travel movement across the border. Indigenous forests require control measures to counter adverse impacts of long-established introduced pest and weed species. Widespread vertebrate pests (both possums and other species) cause browse and predation damage.

An estimated 10 percent of the plantation forest estate was affected by diseases in 2013. Major outbreaks of *Cyclaneusma* needle cast and *Dothistroma* needle blight are generally similar in extent on a year-to-year basis. The diseases involved mostly affect tree growth rates and wood quality, rather than resulting in mortality.

Wind is the major abiotic agent affecting New Zealand's forests, having impacts on the commercial value of planted forests. Historical records indicate that about 0.21 percent of the net stocked plantation forest area is lost annually due to wind damage and further research using historic data is improving prediction of risk of wind damage in planted forest. Windthrow is common in indigenous beech forests and a key factor in the natural ecology. Wind damage is less common in other indigenous forest types and the damage varies with species. Less frequent also is extensive windthrow across a range of forest types. Cyclone Ita in April 2014 was one such storm, which resulted in an assessed 40 880 hectares of windthrow damage to indigenous forests in the South Island's West Coast region.

The forest area affected by fire varies significantly from year to year, but by international comparisons the impact is small. Damage to planted and indigenous forests over the six-year period from 2007 to 2013 is about 4000 hectares and 500 hectares respectively.

Indicator 3.a Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions

In 2013, less than 1 percent of the total plantation forest area was affected by insects and about 1 percent of the total plantation forest area was affected by diseases, the most important of which are: Cyclaneusma needle cast, Dothistroma needle blight, Armillaria root rot and Nectria flute canker.

The introduced Australian brushtail possum continues to be widespread in indigenous forests. Forest health records indicate that, in 2013, possums affected eight percent of the plantation forest estate.

Quality of information: M/H

Progress against indicator: ▲

Rationale

This indicator identifies the impact of biotic processes and agents have on forests. Where change due to these agents and processes occurs beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover could be reduced or lost. Monitoring and measuring the effects of these processes provide information helpful in the formulation of management strategies to mitigate risk.

NEW ZEALAND'S REPORT

Forest area affected by insects and diseases

Historically, very few insect problems have been noted in plantation forests, apart from one species of bark beetle *(Hylastes ater)* that can be associated with seedling death (Bulman, 2008). All major exotic plantation forests are inspected at least once a year for signs of newly established pests or diseases: forest health assessments are undertaken, and damage by biotic and abiotic agents estimated and recorded.

The most important fungal diseases affecting pine plantations are: needle cast *(Cyclaneusma minus),* needle blight *(Dothistroma septosporum),* root rot (*Armillaria* spp.) and flute canker *(Neonectria fuckeliana (syn. Nectria fuckeliana)*. Diseases in plantations of other species include:

- **Swiss needle cast** *(Phaeocryptopus gaeumannii)* **affecting Douglas-fir.** The disease is well established in New Zealand stands, affecting growth rate with a range of severity nationally but having most impact in warmer and northern sites. Direct control through spraying is not considered economic, but trials of varieties that may be less susceptible to the disease on the more affected sites are under way.
- **Cypress canker** ***(Seiridium*** **spp.) affecting a number of cypress species.** Severity of the disease varies with species, site, climate and inoculum loadings. About 75 percent of New Zealand stands are estimated to be affected to some extent.
- **Various root and leaf pathogens affecting eucalypts.** New Zealand has about 23 000 hectares of plantation eucalypt species. At least half of that area is affected by insect pests (mainly *Paropsis* beetle in the central North Island and Southland) and diseases (caused by various leaf spot fungi) in the central North Island.

Table 3.2 identifies the planted forest area affected by insects and diseases in 2013. The most recent estimated of the economic losses from diseases affecting plantation forests is a cost of about $83 million per annum (Table 3.3); slightly more than the estimate for 2008 ($82 million). In both 2003 and 2008, *Cyclaneusma* needle cast and *Dothistroma* needle blight were the pathogens that caused the most loss, but outbreaks of these diseases have been less extensive in recent years (Table 3.4). Drier conditions and more effective copper spray formulations have reduced *Dothistroma* incidence, while the reduction in forest areas in the central North Island through land conversions has diminished the spray requirement. The production of resistant clones has helped to reduce *Cyclaneusma* incidence.

Damage to radiata pine due to *Nectria* flute canker remains confined to the lower South Island of New Zealand and management regimes have reduced the disease incidence in stands. This disease was first recognised in the early 2000s but may have been established in New Zealand for some years prior.

Incidences of both cypress canker and diseases in eucalypt species have increased. Dutch elm disease affecting urban trees remains confined to the Auckland area and control involves a trapping programme for the disease vector beetle species.

Kauri dieback disease caused by the pathogen *Phytophthora* taxon Agathis (interim name) affects kauri of all ages and is present in a number of the northern kauri forests. Work is under way to detect the extent and pattern of spread of the pathogen, and more formal identification of the fungus and methods of control. Surveys of distribution are continuing. Publicised hygiene measures to limit physical spread include footwear cleaning and forest access management.

Invertebrate invasive pests – wasps

Four species of social wasps, accidentally introduced to New Zealand, are now established and classed as pests. Two of the four species are vespulid wasps (common and German); the other two species are paper wasps (Asian and Australian).

Social wasps are a pest of urban, rural and natural ecosystems. They pose a health risk; affect the profitability and safety of industries such as beekeeping, horticulture, forestry and tourism; and upset the ecological balance in native ecosystems. Wasps are a significant pest in forest areas, especially in beech forests where high populations can develop due to their attraction to honeydew – a sweet exudate of tree-dwelling scale insects. In forests, wasps can displace birds by competing for food such as honeydew, or by driving them from the habitat. Control methods are largely through chemical use either by direct destruction of nests or through bait carried back to nest by foraging wasps.

Table 3.2: Forest area affected by insects and diseases (2013)

Disturbance	Planted forest area (000 hectares)[1]	% of total plantation forest[2]
Disturbance by insects	14	>1
Disturbance by diseases	174	10

Sources: 1. Bulman, 2014.
2. Derived from Ministry for Primary Industries, 2014a.

Table 3.3: Economic losses from diseases affecting plantation forests

Disease	Tree species or genera affected (scientific name)	Loss/cost ($ million per annum)	Operational response
Cyclaneusma minus	*Pinus radiata*	$38	Breeding for resistance
Dothistroma septosporum	*Pinus radiata*	$19.8	Copper spray, silviculture, breeding
Diplodia (vector-*Sphaeropsis sapinaea*)	*Pinus radiata*	$4	Avoid pruning in summer
Neonectria fuckeliana (syn. *Nectria fuckeliana*)	*Pinus radiata*	$10	
Others	*Pinus radiata*	$8	Not specific
Phaeocryptopus gaeumannii	*Pseudotsuga menziesii*	$2.3	Breeding for resistance
Cypress cankers	*Cupressus spp.*	$1	Site and species selection, breeding
Research diagnosis and surveillance	All plantation species	$3	
TOTAL		**$83.1**	

Sources: Bulman, 2014; Kimberley et al, 2011.

Vertebrate invasive pests – possum

The introduced Australian brushtail possum *(Trichosurus vulpecula)* is considered a major forest pest in New Zealand. Possums are widespread, can attain high densities and browse on some canopy and sub-canopy trees. Possums are also significant predators of some indigenous native birds and invertebrates.

Possums living in or adjacent to plantations commonly use radiata pine as a seasonal food source, including foliage and cones, which subjects the trees to browse and secondary physical damage. Historic reports of possum damage in planted forest indicate the greatest reported damage coincided with significant cycles of replanting and establishment, such as in the 1960s and then again in the 1990s, indicating possums' preference for young stands.

Trappers' control of possum numbers in accessible areas, with the currently high prices for possum fur, and the effective outcomes of the bovine tuberculosis control programmes (see below) are two key factors helping control possums numbers across the New Zealand planted forest estate. Forest owners and managers report that possum numbers have remained constant over the last five years and damage is generally minimal due to both factors. However, while trappers are controlling possum numbers in accessible areas, populations are still high in some remote areas. Some report isolated damage in planted forests adjacent to some indigenous forest areas where control measures have been limited.

Based on forest health inspection records in the forest health database (Table 3.5), the area affected by possums has continued to decrease. Over the five-year period from 1998 to 2002 just over 2900 (580 per year) records of possum damage were made. Numbers declined to 260 per year during 2003 to 2008, and since then (2009 to mid 2014) about 150 records of possum damage have been logged. With the average area affected at 200 hectares per record, this equates to 30 000 hectares over the entire estate.

Possums can carry bovine tuberculosis (Tb). TBfree New Zealand, a government-industry partnership (previously the Animal Health Board), supports research into, and treats forest areas for, control of possums where the spread of Tb into livestock is a problem. Sodium monofluoroacetate (1080), applied across forest areas in aerial spread baits to control possums and other vertebrate pests, remains a core method for large-scale control. This attracts both opposition and support from the public, but is currently regarded as the most practicable extensive

Table 3.4: Trend in incidence of major diseases in plantation forests

Description	Tree species or genera affected (scientific name)	Year(s) of latest outbreak	Area affected (000 hectares)	Severity of disease during 2008–2013
Dothistroma needle blight	*Pinus radiata*	2013	61	Reducing incidence favoured by climatic conditions and more effective copper formulation
Dothistroma needle blight	*Pinus radiata*	2006	130	
Dothistroma needle blight	*Pinus radiata*	2002	183	
Dothistroma needle blight	*Pinus radiata*	1995	115	
Dothistroma needle blight	*Pinus radiata*	1989	119	
Cyclaneusma needle cast	*Pinus radiata*	2013	40	Reducing incidence favoured by increased use of resistant clones
Cyclaneusma needle cast	*Pinus radiata*	2000	150	
Cyclaneusma needle cast	*Pinus radiata*	1999	200	
Swiss needle cast fungus	*Pseudotsuga menziesii*	No specific outbreaks	40	Constant incidence nationally but greater in North Island stands
Cypress canker	*Cupressus* spp. *x Cupressocyparis* spp. *& Chamaecyparis* spp.	No specific outbreaks	7.5	Increased incidence over time attributed to multiple factors. (climate, species choice sites, inoculum loadings) Variable severity of infection affecting about 75% of stands
Various	*Eucalyptus* spp.[1]	Root and foliage pathogens No specific outbreaks	25	Increased incidence over time. Variable severity of infection affecting about 50% of stands

Note 1: Insect pest damage in eucalypts, notably *Paropsis* spp., is a significant management problem in stands of some commercial eucalypt species.
Source: Bulman, 2014.

Table 3.5: Forest area affected by possums (000 hectares) (2013)

	Forest area (000 ha)	Percentage of total area
Plantation forest	140	8
Indigenous forest	6 704	81

Sources: Bellingham et al, 2013; D Brown, Department of Conservation (unpubl); Bulman, 2014; MacLeod et al, 2012.

control method, especially over terrain with limited ground access. Aerial 1080 operations covered approximately 432 000 hectares of land in 2012.

Possums are present in indigenous forests throughout the North, South and Stewart Islands although the impact from possum browsing in indigenous forests varies across the range of New Zealand forest types. A range of biotic and abiotic factors also affects browsing patterns in forests that may predispose some plant communities to possum damage. Browsing occurs in highly preferred canopy and sub-canopy species and high densities of possums can result in defoliation and death of individual trees subject to browsing.

Brushtail possum.

Understanding the distribution, abundance and impact of possums in New Zealand indigenous forests is clearly fundamental to effective control of the pest. This has improved greatly since the establishment of the Land Use and Carbon Analysis System (LUCAS) permanent plot network in 2005 and the recent implementation of the Department of Conservation's Biodiversity Monitoring and Reporting System (BMRS) (see also Indicator 1.3.b). Two measures are used in identifying pest levels. 'Occupancy' is the proportion of sampling locations occupied by the species and 'relative abundance' refers to the number of a species present relative to all species at a site. In 2013, possums occupied 81 percent of indigenous forest on public conservation land with an overall relative abundance of 4.5 percent (Bellingham et al, 2013).

Results from the BMRS show that possums are less abundant in beech than in non-beech forests. Abundance, but not occupancy, was statistically lower in national parks compared with other conservation lands. Possum abundances were considerably lower than previous estimates both nationally and in low-altitude forests. The reason for this is not immediately obvious, but may result from earlier estimates focusing on sites where possums were known to be present, and the use of different methods for estimating

Table 3.6: Total area (forest and non-forest) of public conservation land under sustained possum control management and areas under targeted possum control treatment in any one year

Year ended 30 June	2009	2010	2011	2012	2013
Sustained control (000 ha)	1 100	1 024	1 080	1 024	1 011
Annual targeted treatment (000 ha)	188	285	224	235	184

Source: Department of Conservation, 2013.

abundance. The highest abundances were found in North Island and Stewart Island forests.

The aim of pest control is to reduce both occupancy and relative abundance of the pest species to the point where the relative abundances of favoured native species (at a site) are showing signs of recovery. The success of controls can be gauged by measuring these changes, although such monitoring is challenging at the extensive scale required for the pest population across New Zealand indigenous forests. Nevertheless, it is anticipated that measurements of the percentage change in the relative abundance over time, indicating the effectiveness of controls, will be available in a forthcoming reporting cycle. (Refer also to discussion under Indicator 1.3.b.)

Trends in the size distributions of canopy and sub-canopy tree species were evaluated on public conservation land between the periods 2002–2007 and 2009–2012 (MacLeod et al, 2012). These data show that kāmahi, New Zealand's most common tree and a preferred browse species for possums (and also for introduced ungulates), is continuing to regenerate on public conservation land (MacLeod et al, 2012) (see also indicator 1.3.b).

In the past 15 years, possum control efforts have significantly increased in extent and intensity. Possum control measures in the Department of Conservation-administered public conservation estate (forested and non-forest land) include: sustained possum control, which increased from 669 000 hectares in 2000 to a peak of 1 100 000 hectares in 2009, and control treatments in specific targeted areas (see Table 3.6).

Vertebrate invasive pests – ungulates

Many species of ungulate have established wild populations in New Zealand (King, 2005): feral goats *(Capra hircus),* red deer *(Cervus elaphus scoticus),* wapiti *(C. elaphus nelsoni),* white-tailed deer *(Odocoileus virginianus),* sambar deer *(Rusa unicolor),* sika deer *(C. nippon),* rusa deer *(R. timorensis),* fallow deer *(Dama dama),* Himalayan tahr *(Hemitragus jemlahicus),* alpine chamois *(Rupicapra rupicapra),* feral sheep *(Ovis aries)* and feral cattle *(Bos taurus).* These ungulates can alter the growth and survival rates of plants by browsing and trampling, which leads to the replacement of preferred, browse-intolerant plant species by less preferred or avoided species (Forsyth et al, 2010).

Ungulates are commonly present in New Zealand forests. As with possums, measuring and monitoring occupancy and relative abundance are the keys to ungulate control. The BMRS (Allen et al, 2009; Bellingham et al, 2013; MacLeod et al, 2012) indicated that, in 2012 and 2013, wild deer and/or feral goats occupied 75 percent of indigenous forest on public conservation land (Table 3.7), but were mostly present at low abundances relative to the high abundances observed in the 1950s to 1970s. Occupancy and relative abundances of deer and/or feral goats were higher on Stewart Island and the North Island than the South Island. BMRS data show that ungulates were statistically less abundant in beech than in non-beech forests. Occupancy and abundance did not differ between national parks and other conservation lands.

Table 3.7: Indigenous forest area affected by introduced ungulates

Disturbance	Indigenous forest area (000 ha)	% of total indigenous forest
Disturbance by ungulates	6 207	75

Sources: Bellingham et al, 2013; MacLeod et al, 2012.

Table 3.8: Total area (forest and non-forest) of public conservation land under sustained feral goat and deer control by the Department of Conservation

Year ended 30 June	2009	2010	2011	2012	2013
Feral goat control area (000 ha)	2 389	2 185	2 221	2 357	2 311
Deer control area (000 ha)	769	721	732	732	550

Source: Department of Conservation, 2013.

Observations in ungulate exclosure plots, measuring 20 by 20 metres, indicate that:

- selective browsing favours an increase of some browse-resistant, or tolerant, species in the understorey on some sites, and more generally across the national ungulate exclosure system;
- ungulate impacts are less significant in mature than disturbed forest stands.

Control operations for deer and feral goat (Table 3.8), and possum, have significantly reduced abundance levels. Together with sustained hunting, they have enabled favoured browse species such as kāmahi to regain adequate regeneration levels.

Effects of mustelids

Mustelids are members of the animal family Mustelidae, all carnivores native to the northern hemisphere. Three species of mustelids are established in New Zealand: stoats *(Mustela erminea),* weasels *(M. nivalis vulgaris)* and ferrets *(M. furo)*. These were introduced to New Zealand in the 19th century and have since established across a wide range of habitats, including into forests. Their prey includes rats and mice, but also a range of indigenous species – birds, lizards and insects. Stoats, especially, have spread to most areas in New Zealand and population increases stimulated by high numbers of rats and mice lead to subsequent predation pressure on bird species when rodent numbers decline.

Trapping and poisoning control measures are undertaken by the Department of Conservation and regional councils.

Indigenous forests affected by non-woody weed species

The assessment of weed species (vascular species exotic to specific sites) in indigenous forested sites forms part of a monitoring and reporting process covering a range of non-forested and forested sites across New Zealand undertaken by the Department of Conservation's Biodiversity Indicators Programme, which is conducted through Landcare Research. The sites are monitored as part of a systematic measurement system and reported on in the Department of Conservation's annual reports. In general, invasive weeds are more prevalent in non-forested and highly modified sites than in forested sites that are more difficult for shade-intolerant weed species to grow in (see also Indicator 1.3.b).

Forest affected by woody invasive species

Indigenous forests in protected areas could be increasingly threatened by weeds, as surrounding land uses intensify and fragmentation of the natural landscape occurs (Timmins and Williams, 1991). Howell (2008) provides a consolidated list of 328 vascular plant species present on Department of Conservation land that are considered to have detrimental effects on the conservation values of sites.

Wilding conifer spread

The term "wildings" refers to the seed-sourced natural regeneration of introduced conifer tree species (particularly pines, Douglas-fir, redwood and larch) originating from stands planted in New Zealand for a

Pine wilding spread, MacKenzie Basin, South Canterbury. Photo: Ian Platt.

variety of purposes over many years. Wilding conifers are a problem primarily in the Marlborough Sounds, the South Island high country and the central plateau of the North Island, but are also invading natural habitats in Otago and the Mackenzie Basin. Wildings can grow in dense stands. They reduce the value of managed pasture, displace native biodiversity and alter the character of the landscape.

The New Zealand Wildling Conifer Management Strategy 2015–2030

Ministry for Primary Industries, 2014b) is a non-regulatory strategy supporting collaborative action between land occupiers, researchers, regulators and communities to address the critical issues facing wilding conifer management. The Strategy has been developed in collaboration with a multi-stakeholder working group and identifies actions for key parties involved in wilding conifer management under four principles: individual and collective responsibility; cost-effective and timely action; prioritisation; and co-ordination. The overall aims of the working group are to prevent the spread of wilding conifers, to contain or eradicate established areas of wilding conifers by 2030, and to seek the following outcomes:

- key parties collaborate to minimise the negative economic, environmental and landscape impacts of wilding conifers;
- communities are aware of and taking actions for the prevention and effective management of wilding conifers;
- beneficial conifer plantings continue;
- landowners do not establish conifer plantings at high risk of spreading on spread-prone sites, and reduce or prevent spread from new and existing wilding conifer populations;
- wilding conifer management and control are timely and cost-effective.

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Indicator 3.b Area and percent of forests affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions

Some 63 000 hectares of planted forest area have been damaged by storm events between 1945 and 2008, and modelling of storm records is a tool to predict risk of damage.

The precise causes of physiological needle blight (PNB), considered a disturbance caused by abiotic factors, and the associated pathogen remain under investigation. PNB affected a little less than 1 percent of the total plantation forest area annually on average during 2009–2013.

In the six-year period from 2007 to 2013, wildfire incidents affected about 4000 hectares of plantation forest and about 500 hectares of indigenous forest.

Rationale

This indicator identifies the impact of abiotic processes and agents on forests. Where change due to these agents and processes occurs beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover could be reduced or lost. Monitoring and measuring the effects of these processes provide information helpful in the formulation of management strategies to mitigate risk.

NEW ZEALAND'S REPORT

Effect of wind damage on forests

Wind is the main abiotic factor affecting plantation forests in New Zealand. Records of wind damage indicate that a total of 63 000 hectares of forest were damaged over a period from 1945 to 2008. Three main storm events contributed two-thirds of the total damage over the 50-year period. Recent work on analysis of wind damage records of plantations (Moore et al, 2013) shows an average of 0.21 percent of the national net stocked area affected by wind annually, across a range of 0.98 in the most affected to 0.03 percent in the least, affected wood supply regions. By modelling wind event data, the same study estimated that 500 hectares of damage nationally would occur every five years, with a 95 percent expectation of such damage occurring between 4.5 and 6.2 years. Similarly, 1000 hectares of damage might be expected every 6.4 years, with the 95 percent expectation of this happening between 4.8 and 9.9 years. Such work assists forest owners to better understand risks of losses potentially affecting their emission liabilities under the New Zealand Emissions Trading Scheme.

Damage in indigenous forests is well reported in many anecdotal accounts of specific storm events with detail on species, size, location and local physical conditions. Where these forests occupy sites prone to stormy conditions, such as mountain areas, wind damage can be a common occurrence and the structure and composition of some forest types, notably beech forest on such sites, are governed by disturbance (Wardle, 1984).

Cyclone Ita in April 2014 affected an unusually extensive area of indigenous forests in the South Island's West Coast region, and caused windthrow damage across a range of forest types and geographic areas, including lowland podocarp forest. The forest area affected was assessed at 40 880 hectares in both private lands and the public conservation estate (Ministry for Primary Industries, 2014).

Forest area affected by other abiotic factors

Periodic severe seasonal needle cast of radiata pine of unknown origin has been recorded in a number of locations throughout New Zealand since the early 1980s. This has been termed physiological needle blight (PNB) and is considered a disturbance caused by abiotic factors. The disorder affects trees 15 years and older and causes foliage to turn red brown

and die, while still attached to the tree. To date, the precise cause of PNB is unknown, but investigation has focused on both the mechanisms that promote the symptoms and the subsequent pathogen infection causing needle death. PNB occurs in radiata pine plantations in late winter or early spring and is associated with high water availability, in winter (in particular high mid-winter rainfall) and high canopy humidity. PNB outbreaks have often been associated with non-porous soils (Forest Biosecurity Research Council, 2006).

Mapping of field observations indicates that the incidence of PNB is relatively high in the northern part of the North Island, compared with lower incidence at sites further south. PNB incidence remains sporadic and is estimated to have affected about 15 000 hectares of planted forest per year on average in the 2009–2013 period (Bulman, personal communication, 2015).

Forest area affected by fire

Table 3.9 records the area affected by fire for planted and indigenous forests from annual fire returns provided by the National Rural Fire Authority, which gathers information on fire incidence. Controlled fire is no longer widely used as a site preparation tool in New Zealand forest management, although controlled fire is used as part of fire management training. Controlling wildfire in forests, during drought periods, remains a management issue.

Forest clearance

Information on deforestation (permanent clearance of forest) is obtained from time series mapping of land use change and through annually updated forest owner surveys of deforestation intentions; these sources therefore provide information about historical clearance as well as likely clearance in current and future years. Both these sources are primarily for assessing current and future forest carbon levels used to monitor the Government's international climate change commitments and New Zealand Emissions Trading Scheme (ETS), and also assist with future climate change policy development.

Time-series mapping (in the *New Zealand Greenhouse Gas Inventory 1990–2012* (Ministry for the Environment, 2014) and the New Zealand Land Cover Database Version 3 provide estimates of deforestation of indigenous forest over the period since January 1990. These sources indicate that annual clearance was higher prior to regulatory measures such as through the Resource Management Act 1991 and the Forests Act 1949, as well as before commitments were made under the 1991 New Zealand Forest Accord – an agreement between the forest industry and conservation groups on limiting the clearance of indigenous forests.

Deforestation in plantation forests (including both climate change policy categories of pre-1990 and post-1989 forest) increased significantly after 2002,

Table 3.9: Forest area affected by wildfires

Forest fires	Area affected by wildfires (ha)					
	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13
Plantation forest fires	1150.34	164.72	1202.51	440.76	559.35	434.51
Indigenous forest fires	23.73	283.96	78.77	29.04	31.00	56.15
TOTAL forest fires	**1174.07**	**448.68**	**1281.28**	**469.8**	**590.35**	**490.66**

Source: New Zealand Fire Service, 2013.

Table 3.10: Area of deforestation (hectares)

Forest land subcategory	1990 to 2012	2008	2009	2010	2011	2012
Pre-1990 natural forest	39 098	864	1 895	1 297	853	811
Pre-1990 planted forest	91 855	4 154	6 008	4 842	4 182	5 384
Post-1989 planted forest	20 591	965	2 501	1 082	1 092	567
TOTAL area	**151 544**	**5 983**	**10 404**	**7 221**	**6 127**	**6 762**

Source: Ministry for the Environment, 2014.

rising to a peak just before the ETS policy started in 2008. This rise was due in part to forest landowners anticipating deforestation liabilities under the ETS, the price of emission units and the relative attractiveness of alternative land uses, such as dairy farming. The *2013 annual deforestation survey* (Manley, 2014) reports that forest owners' intentions to deforest in future years (2014–2020) are scaled back slightly from the 2012 survey.

Table 3.10 lists areas deforested since 1990 and by years since 2008, using forest categories established under the Kyoto Protocol.

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Cyclone Ita storm damage to West Coast forest, April 2014. Photo: Ian Platt.

CRITERION 4:
CONSERVATION AND MAINTENANCE OF SOIL AND WATER RESOURCES

Soil and water resources underpin forest ecosystem productivity and functions. Forest ecosystems play an important role in the regulation of surface and groundwater flow and, together with associated aquatic ecosystems and clean water, are essential to the quality of human life.

The interaction of soil, water and topography influence the character and health of streams and rivers flowing through and from forests. Monitoring change in the chemical, physical and biological characteristics of soil, water and aquatic systems provides valuable information to support sustainable forest management.

Forest management activities can significantly alter forest soils, water quality and associated aquatic habitats. Inappropriate management may result in soil compaction, the loss of the soil A horizon, loss of riparian buffering capacity, increased sediment loads in streams, degradation and destruction of aquatic habitats and altered flow regimes. Change in water flow can also create an increased risk of flooding or the complete desiccation of streams. Both have harmful implications for human safety, property and economies.

Soil and water resources may be protected through the allocation of land for that purpose or through appropriate management regimes and best management practices.

Table 4.1 lists the indicators covered in this section.

Table 4.1: Indicators for Criterion 4 – quality of information and trends

	Criterion 4: Conservation and maintenance of soil and water resources	Quality of information	Trend
	Protective function		
4.1.a	Area and percent of forest whose designation or land management focus is the protection of soil or water resources	L	▶
	Soil		
4.2.a	Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources	M/H	▲
4.2.b	Area and percent of forest land with significant soil degradation	L/M	▶
	Water		
4.3.a	Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources	M	▲
4.3.b	Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions	L	▶

KEY

L = low	Neutral ▶
M = medium	Positive ▲
H = high	Negative ▼

NEW ZEALAND OVERVIEW

Key achievements since 2008 are:

- the addition of further sections to the *New Zealand Environmental Code of Practice for Plantation Forestry* by the New Zealand Forest Owners Association;
- the publication by the New Zealand Forest Owners Association of the *New Zealand Forest Road Engineering Manual*;
- an increase from 55 percent to 61 percent of the plantation forest resource under Forest Stewardship Council certification;
- modest increases in the area under forest cover for the mitigation of soil erosion (under the Erosion Control Funding Programme (East Coast) and the Sustainable Land Management (Hill Country) Erosion Programme;
- the issuing by the Government of a National Policy Statement for Freshwater Management.

Natural soil erosion is a significant feature of New Zealand hill country and mountain areas. With a young and active geology, and a high storm frequency, much of this landscape is vulnerable to accelerated soil erosion through inappropriate land and forest use. About 6.7 million hectares of forests, including virtually all indigenous forests, fulfil vital water and soil protection functions. The risk or incidence of active soil erosion is moderate or higher under about 25 percent of indigenous forests and 17 percent of plantation forests. Surprisingly, land and forest management planning does not commonly embrace a specific designation for the protection of soil and water values.

The Resource Management Act 1991 (RMA) is the overarching legislation for the sustainable management of natural and physical resources. Forestry (and other land management) activities that have the potential to have significant adverse effects on soil and water values are subject to provisions of plans prepared under the RMA. Resource consents from the administering local authority may be required before certain activities can commence.

Sustainable (indigenous) forest management plans and permits under Part 3A of the Forests Act 1949 are also required to maintain the natural values of forest ecosystems.

The New Zealand Forest Owners Association published the *New Zealand Environmental Code of Practice for Plantation Forestry* in 2007, which replaces earlier codes of practice. The Association recommends that its members adhere to the principles and practices within the Code, which emphasise best management practices for soil and water quality values.

Independent third-party forest certification provides a market-driven mechanism to ensure the country has well-managed forests that protect soil and water resources. The area of forests under third-party certification continues to increase, with about 61 percent (net stocked area) of the plantation forest estate now under Forest Stewardship Council certification.

Little analysed national information is available on changes in physical, chemical or biological properties of streams in forest catchments. Substantial information is available at the regional level.

INDICATOR 4.1 PROTECTIVE FUNCTION

Indicator 4.1.a Area and percent of forest whose designation or land management focus is the protection of soil or water resources

New Zealand has significant areas of natural and accelerated soil erosion, but the designation of protection forest land is no longer applied in most management planning. Although forest land is still managed with conservation of soil and water resources as implied objectives, and sometimes as specific objectives, national data on the extent of such management are derived estimates only.

Since 2008, progress has been modest in the management of land for soil and water values through further forest establishment under the Erosion Control Funding Programme (East Coast), and initiatives under the Sustainable Land Management (Hill Country) Erosion Programme.

Quality of information: L

Progress against indicator: ▶

Rationale

The area and percent of forest designated or managed primarily for the protection and regulation of soil and water reflects the importance of these resources to society, including the trade-offs made between other uses.

NEW ZEALAND'S REPORT

The New Zealand Country Report for the Food and Agriculture Organization's Global Forest Resource Assessment (Ministry for Primary Industries, 2014) indicates 6.742 million hectares of indigenous and plantation forest have soil and water protection functions. This assumes that nearly all indigenous forests fulfil these roles, although little if any is specifically designated for this purpose.

Co-ordinated efforts to manage hill country erosion date from the early part of the 20th century. This work led to the passage of the Soil Conservation and Rivers Control Act in 1941. This Act authorised the establishment of local catchment boards, tasked with co-ordinating soil and water conservation. The boards provided financial assistance to landowners to carry out flood protection and soil conservation works. Many of these works involved tree planting programmes to stabilise slopes and reduce sediment yield.

The catchment boards were rolled into a new regional council structure in 1989 and the focus went on to providing landowners with technical information on and assistance with sustainably managing their properties. In a number of regions, some financial support continued to be available for land management plantings (such as riparian plantings along streams).

The annual cost of hill country soil erosion (mainly in pastoral use) is reported to be $100 million to $150 million. These national estimates of the cost of soil erosion and sedimentation in New Zealand are based on Krausse et al (2001), who estimated the order-of-magnitude average annual cost to be $127 million.

Patterson and Cole (1999, 2013) have looked at the total economic value of New Zealand's land-based ecosystems and the services they provide. In examining forest ecosystems, they valued erosion control at $2092 million, second only to the production of raw materials. In particular, they found that indigenous forests "play a critical role in maintaining soils and preventing sediment loss on land that is often steep and unstable" (Patterson and Cole, 2013, p 503).

Indigenous forests

Much of the indigenous forest on the mountain and hill country of New Zealand has historically been referred to as "protection forest". This reflects the naturally unstable nature of the terrain, and also the important roles the forest vegetation plays in reducing soil erosion and maintaining water values.

McKelvey (1995) identified 4.3 million hectares (69 percent) of indigenous forests as being protection forests. This area comprised 1.68 million hectares of upland forest and 2.62 million hectares of lowland forest. All upland forest was considered important for the protection of soil and water values.

These forests are considered to have a strong slope-stabilising influence with low-intensity storms. However, natural erosion processes coupled with high-intensity/low-frequency storm events may initiate mass movements on steep, forested slopes (McKelvey, 1995).

The Forests Act 1949 specifically recognised the use of state forest land for soil and water conservation, and a forest zoning system that evolved in the 1970s had a specific soil and water protection category. Since the management of state indigenous forests was transferred from the disestablished New Zealand Forest Service to the (then new) Department of Conservation in 1987, these forests have been managed "…for conservation purposes…" under section 6(a) of the Conservation Act 1987. The term "protection forest" is not now commonly used in forest management planning.

The Conservation Act 1987 interpretes conservation as including protection of natural resources such as forest vegetation, so the roles the vegetation performs in protecting soil and water resources are maintained.

Some indigenous forested catchments are also managed for the supply of domestic drinking water – for example, Wainuiomata catchment in Wellington and the Hunua Ranges in Auckland.

Plantation forests

Plantation forests have also been established for soil and water conservation purposes, although most of the land involved is not formally designated as such.

This includes the planting of Aupouri, Woodhill, Santoft and Bottle Lake forests to stabilise sand dunes. The total area of coastal sand dune planting is estimated to be 67 000 hectares, nearly all of which occurred prior to 1990.

More recently, 42 000 hectares of forests have been established through planting or reversion under the government's Erosion Control Funding Programme (East Coast) (ECFP, formerly the East Coast Forestry Project) for the primary purpose of soil conservation. Some 26 percent of the land on the East Coast is susceptible to severe soil erosion.

The ECFP was established in 1992 to control erosion on the worst eroding or erosion-prone land in this district, and is administered under the Forestry (East Coast) Grants Regulations 1992. It targets 60 000 hectares of the lands at greatest risk, plus immediate surrounding areas. The government provides financial grants for establishing effective tree cover through planting, or encourages natural reversion to indigenous forest.

The ECFP was reviewed in 2011 and 2012. Subsequent changes seek to make landowner participation in the ECFP easier, to remove the requirement for a covenant to be registered against the land title, and to streamline grant payments.

The Sustainable Land Management (Hill Country) Erosion Programme was established by the government in 2007. It supports projects helping hill country farmers treat erosion-prone land and implement sustainable management practices. The total hill country land area at risk of erosion is about 1.14 million hectares, with 300 000 hectares having a severe to extreme risk. Soil conservation initiatives under this programme, including afforestation, are co-ordinated by regional councils who can apply for funding from an annual pool of $2.2 million.

These programmes recognise that avoiding erosion has significant, long-term benefits beyond the productive capacity of New Zealand's pastoral and forest lands. In particular, they improve water quality and protect the "built environment" in rural and urban communities (such as bridges, roads, water supplies and flood banks).

In establishing and managing forests individual land owners make decisions around the focus of their land management. Much of the forest on Māori owned land is managed to protect the whenua (land) for future generations so intrinsically incorporates soil and water conservation in the management objectives.

The economic value of reduced erosion was calculated by Barry et al (2012). They found that afforestation using radiata pine trees on marginal lands in the Gisborne region may provide an avoided erosion benefit in excess of NZ $1000 per hectare in perpetuity. The benefits could be even higher for marginal lands in Gisborne that have steeper slopes (Yao et al, 2013).

(See also Indicator 6.1.c.)

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INDICATOR 4.2 SOIL

Indicator 4.2.a Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources

New Zealand has legislative mechanisms, through the Resource Management Act 1991 and the Forests Act 1949, that address activities that may have adverse effects on soil resources. All commercial forest management must meet the requirements of these Acts. The *New Zealand Environmental Code of Practice for Plantation Forestry* and *New Zealand Forest Road Engineering Manual* also address the mitigation of impacts from forestry operations on soils and are widely promoted by forestry associations. About 61 percent of the plantation forest estate has international Forest Stewardship Council certification, and national certification schemes are being progressed.

Since 2008, new sections have been included in the *New Zealand Environmental Code of Practice,* and the *New Zealand Forest Road Engineering Manual* has been published.

Rationale

The indicator provides information about the extent to which soil resource protection, legislation and best management practices have been identified and integrated into forest management activities. Inappropriate activity may result in the loss of soil nutrients, forest productivity and other ecosystem services that soils provide.

NEW ZEALAND'S REPORT

In addition to legislative and regulatory requirements relating to soil resources, standards and guidelines for indigenous forestry, an environmental code of practice for plantation forestry, and forest certification schemes are in operation.

Resource Management Act 1991

All forest management activities that may adversely affect the soil are subject to the requirements of the Resource Management Act 1991 (RMA). Proposals that will result in disturbances or changes to soil-related resources will usually require a resource consent to be granted by the appropriate local authority. Resource consents commonly specify a number of conditions that must be met in undertaking forestry (or other) activities.

The RMA approach to environmental management centres on the ideas of sustainable management and the integrated management of resources. Regional and district plans are prepared by 78 regional, district and city councils, to assist them to carry out their functions under the RMA. These plans deal with issues relating to soil disturbance through activities such as earthworks, cultivation and removal of vegetation.

Regional councils collect and hold a large amount of soil resource information, the extent of which has not been assessed for this report. Their substantial resources are used for monitoring, planning and reporting activities that relate to soil resources at the sub-national level.

Forests Act 1949

Part 3A of the Forests Act 1949 focuses on privately owned indigenous forests. It promotes the principle of sustainable management by allowing a level of timber harvest that provides for the management of natural (non-timber) values. Landowners and forest managers seeking approvals for sustainable forest management plans and permits on private land must comply with Part 3A of the Act. The Act is administered by the Ministry for Primary Industries (MPI) and contains requirements relating to soil values.

The fifth edition of MPI's *Standards and Guidelines for the Sustainable Management of Indigenous Forests* was published in 2013. It reflects the statutory requirements under Part 3A of the Act and includes a criterion and standards section with indicators relating to soil quality. These cover the siting and construction of earthworks to minimise soil disturbance, and minimising soil compaction and the erosive effects of machine use.

Environmental Code of Practice and Road Engineering Manual

Codes of practice focus on promoting sound management practices and are particularly important for soil conservation. In 2007, the New Zealand Forest Owners Association (NZFOA) published Part 1: Best Environmental Management Practices of the *New Zealand Environmental Code of Practice for Plantation Forestry*. This code replaced the 1993 *New Zealand Forestry Code of Practice*.

Four more parts have subsequently been included in the *New Zealand Environmental Code of Practice*:

- Part 2: Recognising environmental values;
- Part 3: Planning for good environmental outcomes;
- Part 4: Resources and references;
- Part 5: Training.

The Code is a practical means of helping forest planners, contractors and operators to accomplish required levels of environmental performance, consistent with good health and safety and financial performance and the community and regulatory expectations that they face. Soil conservation and quality values and issues are covered in most of the Best Environmental Practices and, in particular, for earthworks, harvesting and mechanical land preparation.

In 2011, NZFOA published the *New Zealand Forest Road Engineering Manual*. The objective of the Manual is to ensure that roads, water crossings and related infrastructure in plantation forests are fit for purpose and are designed and constructed to meet high environmental standards.

Members of the NZFOA and the New Zealand Farm Forestry Association own or manage more than 85 percent of the country's plantation forests. Both organisations strongly endorse the *New Zealand Environmental Code of Practice* and *New Zealand Forest Road Engineering Manual* for their applicability to all forest owners throughout New Zealand, and recommend that their members adhere to the principles and practices.

Forest certification

Forest certification schemes recognise good forest management, including safeguarding soil and water resources.

Most large-scale forest owners in New Zealand have international Forest Stewardship Council (FSC) certification. This provides a third-party guarantee that the products come from forests that have been managed in accordance with FSC principles and criteria.

In FSC terms, this verifies that the forest products come from responsibly-managed forests. Principles 9 and 10 and their associated criteria include the requirements to control erosion of vulnerable soils and slopes, manage infrastructure development, transport activities and silviculture so soils are protected, and manage harvesting of timber so that environmental values (including soils) are protected.

The gross forest area under FSC certification is 1.499 million hectares, of which 1.054 million hectares are productive forest areas (61 percent of the plantation forest estate). This includes 12 000 hectares of indigenous forest managed under Part 3A of the Forests Act 1949.

A New Zealand standard is being prepared with the expectation that FSC endorsement will be sought when it is completed.

Standards New Zealand published standard NZS AS 4708:2014 Sustainable Forest Management in May 2014. It is expected that endorsement under the Programme for Endorsement of Forest Certification will be sought for this standard.

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Pinus radiata plantations, Wairau Valley, Marlborough. Photo: Ian Platt.

Indicator 4.2.b Area and percent of forest land with significant soil degradation

National data on all aspects of soil degradation are not available. About 25 percent of indigenous forests and 16 percent of plantation forests are located on land with moderate or higher incidences of soil erosion. Disturbance or displacement through erosion can cause nutrient loss in soils. Physical soil damage through compaction can result from the concentrated use of heavy machinery. An environmental code of practice addresses these issues and is widely applied.

The area of forest land with significant soil degradation is likely to have remained similar to the area that existed in 2008.

Quality of information: L/M

Progress against indicator: 

Rationale

The indicator provides information on the extent of significant soil degradation in forests likely to affect productivity, hydrology, ecosystem processes or social and cultural benefits. This indicator is primarily concerned with degradation caused directly or indirectly by human activity.

NEW ZEALAND'S REPORT

Considerable information is available on the soil erosion component of soil degradation, but not for other aspects of this issue.

Much of the New Zealand landscape is mountainous or hilly, undergoing uplift, and subject to high-intensity rainfalls. As many areas are underlain by soft, erodible materials (such as recent marine deposits), natural rates of soil erosion are high.

Before human settlement, the extensive indigenous forest land cover provided protection for the soil mantle, except during extreme rainfalls. With much of this indigenous forest cleared, parts of the country are prone to mass-movement soil-erosion processes, particularly in the East Coast of the North Island. Across the country, about 10 percent of the land area is classified as severely erodible.

The remaining indigenous forests often continue to fulfil critical soil conservation roles, mostly unaffected by human activities. However, the introduction of invasive animal pest species in the 19th and early 20th centuries, particularly possums and deer, has impacted on the health and regenerative capacity of some forest types. Hence these animal populations are likely to have some influence on the soil conservation role provided by these forests, even though they are subjected to control operations.

The Ministry for the Environment administers national environmental reporting, although many of the data are collected by other agencies. An Environmental Snapshot report on soil health in 2010 summarises the results from sampling 740 sites between 1995 and 2009 under productive land uses, including plantation forestry. Seven soil measures were monitored, providing information about organic reserves, fertility, acidity and the physical status of the soils. About 60 percent of plantation forestry sites sampled did not meet all target ranges for soil health. For key soil measures:

- 8 percent of the sites did not meet the target range for organic reserves;
- 33 percent of the sites did not meet the target range for fertility;
- 48 percent of the sites did not meet the target range for physical status.

However, much of the plantation forest estate has been established on eroding and erosion-prone sites, some of which have been subject to soil degradation.

Soil erosion

A broad indication of the levels of soil erosion for land under forest cover in New Zealand can be derived from the New Zealand Land Resource Inventory (LRI) and the New Zealand Land Cover Database (see Table 4.2).

Soil erosion peaks and sedimentation may occur during harvesting operations in plantation forests,

Table 4.2: Soil erosion area and percent by forest type

Degree of erosion	INDIGENOUS FOREST		PLANTATION FOREST	
	Area affected (000 ha)	Percentage affected	Area affected (000 ha)	Percentage affected
Unclassified	110	2	1	<1
Negligible	1 337	19	693	34
Slight	3 778	54	988	49
Moderate	1 404	20	274	14
Severe	268	4	46	2
Very severe	51	1	11	1
Extreme	14	<1	3	<1
TOTAL LRI areas	**6 962**		**2 016**	

Sources: Landcare Research, 2014; Ministry for the Environment, 2014.

often due to associated earthworks (the construction of roads and tracks). Earthworks are addressed by the *New Zealand Environmental Code of Practice for Plantation Forestry.* They are commonly subject to provisions of local government plans prepared under the Resource Management Act 1991 (see Indicator 4.2.a). The period between harvesting and the re-establishment of good vegetation cover and root networks may also see elevated levels of soil erosion.

Very little harvesting occurs in indigenous forests. However, where harvesting is undertaken, it concerns single trees, small groups of trees or small coupes under the sustainable forest management requirements of the Forests Act 1949, and often by helicopter.

New Zealand Empirical Erosion Model

Scientists from the Sustainable Land Use Research Initiative developed the New Zealand Empirical Erosion Model (NZeem®), which predicts mean annual sediment yield from a given catchment based on annual rainfall, type of terrain and percentage of woody vegetation cover. The model can calculate the likely extent of erosion under different types of land cover. This will enable prioritising soil conservation work and defining those areas that would benefit from tree cover.

Nutrient supply

Disturbance or displacement through soil erosion can cause nutrient loss. Although there is no evidence in New Zealand that successive harvests cause severe decrease in soil nutrient supply, an early classification by Hunter et al (1988) suggested some soils will be less able to maintain nutrient supply than others.

Large-scale plantation forest managers commonly monitor nutrient levels through foliage and/or soil analyses. Fertilisers are applied where nutrient deficiencies would adversely affect tree growth, and to maintain long-term productivity.

Soil compaction

The major cause of soil compaction on forested sites is the concentrated use of heavy machinery (for example, on landings for harvesting operations), particularly when soil moisture levels are high. This issue is also addressed under the *New Zealand Environmental Code of Practice for Plantation Forestry* with guidance notes provided on how to mitigate soil compaction.

No national data on soil compaction under forested land are available.

Government sustainable land management initiatives

Several sustainable land management initiatives supported by government are designed to address soil erosion through forest establishment. These include the Erosion Control Funding Programme (East Coast) (formerly the East Coast Forestry Project), and the Sustainable Land Management (Hill Country) Erosion Programme.

The Permanent Forest Sink Initiative focuses on carbon sequestration and storage, but some of the afforestation is likely to be on eroding land. While not specifically implemented for soil erosion control, this is likely to be a secondary benefit.

Sources of information

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Further reading

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Mead, DJ (2005). Fertilising. In Colley, M (ed) *Forestry handbook* (4th edition). New Zealand Institute of Forestry (Inc); Christchurch.

Beech-podocarp forest, Aorere River, Golden Bay. Photo: Ian Platt.

INDICATOR 4.3 WATER

Indicator 4.3.a Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources

The New Zealand Government issued a National Policy Statement for Freshwater Management in 2011 and amendments in 2014 that provide direction to local government on the management of water resources.

Legislative mechanisms through the Resource Management Act 1991 and the Forests Act 1949 relate to activities that may affect riparian zones, and water quality and quantity. The area of plantation forest certified by the Forest Stewardship Council has increased to 61 percent of the estate.

Since 2008, in addition to the National Policy Statement, further sections have been included in the *New Zealand Environmental Code of Practice for Plantation Forestry* and a revised edition of the *Standards and Guidelines for the Sustainable Management of Indigenous Forests* has been published. Both publications address the protection of water resources.

Rationale

This indicator provides information about the extent to which water resources have been identified and safeguarded during forest management. This indicator is primarily concerned with activities that may affect riparian zones, water quality, quantity and flow rather than the designation of land for water-related conservation. The protection of water resources and associated forest and aquatic ecosystems is vital for the human populations dependent on them.

NEW ZEALAND'S REPORT

New Zealand manages its water resources in accordance with the Resource Management Act 1991 (RMA). In addition to the legislative requirements relating to water resources, there are standards and guidelines for indigenous forestry, an environmental code of practice for plantation forestry, and forest certification schemes.

Resource Management Act 1991

A National Policy Statement for Freshwater Management was issued by the Government under the RMA in 2011, and amended in 2014.

The National Policy Statement directs regional councils to consider specific matters (including the setting of objectives, policies and rules) about fresh water when they are developing regional plans for fresh water. The councils are required to gather water quality and quantity information on water bodies to assess their current state and decide the water quality objective for each value communities chose based on economic, social, cultural and environmental impacts on those communities.

All forest management activities that may affect riparian zones, and water quality, quantity and flow are subject to the requirements of the RMA. Local authority plans prepared under the RMA deal with issues relating to water quality and quantity, and may include rules relating to riparian areas, set-backs for plantation forestry, requirements for stream and river crossings, the classification of rivers and streams according to their values and requirements for water monitoring.

The discussion on the RMA under Indicator 4.2.a is also relevant to the protection of water resources.

Forests Act 1949

Landowners and forest managers seeking approvals for sustainable forest management plans and permits on privately owned indigenous forest land must comply with Part 3A of the Forests Act 1949. The Act is

administered by the Ministry for Primary Industries (MPI), which considers water values in their processes.

The fifth edition of MPI's *Standards and Guidelines for the Sustainable Management of Indigenous Forests* was published in 2013. The Standards and Guidelines reflect the statutory requirements under Part 3A of the Forests Act 1949 and include a criterion and standards with indicators relating to water quality. These include the protection of permanent stream beds and stream margins.

Environmental Code of Practice and Forest Road Engineering Manual

Indicator 4.2.a discusses the *New Zealand Environmental Code of Practice for Plantation Forestry* and the *New Zealand Forest Road Engineering Manual*. Water quality values and issues are covered in most of the Best Environmental Management Practices under the Code and through the information in the Manual.

With respect to riparian management, the *New Zealand Environmental Code of Practice* states that a minimum setback from planting of 5 metres is generally recognised as appropriate for small, permanently flowing streams, while wider widths are often established on the margins of wetlands and geothermal areas or adjacent to larger streams and rivers.

Forest certification

Most large-scale plantation forest owners in New Zealand have international Forest Stewardship Council (FSC) certification. The area certified accounts for 61 percent of the plantation forest estate. Certification provides an independent and credible guarantee that the products come from forests that have been managed in accordance with FSC Principles and Criteria. In FSC terms, this certification verifies that the forest products come from responsibly managed forests.

FSC Principles 6, 9 and 10 all include criteria that relate to the management of water resources.

See Indicator 4.2.a for data on the area of forests with FSC certification, the preparation of a New Zealand standard for FSC endorsement, and the expectation that endorsement under the Programme for Endorsement of Forest Certification will be sought for standard NZS AS 4708:2014 Sustainable Forest Management.

Sources of information

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Indicator 4.3.b Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions

At the national level, New Zealand has no river quality monitoring by land use cover, and no substantive information available on changes in physical, chemical or biological properties of streams in forest areas. Monitoring is undertaken on a regional basis. The quality of water from forest catchments is generally considered to be high. For plantation forests, the most significant measured changes to water quality have been increases in suspended sediment.

Since 2008, the national level information available on the properties of streams flowing through forested land has changed little.

Rationale

This indicator provides information relating to water quality in forests. Significant changes in the physical, chemical or biological properties of water in forest lakes, rivers and streams may reveal the extent to which management activities or natural events are affecting water quality. Maintaining water quality is important for human use and consumption and to support healthy forest and aquatic ecosystems. Where water quality is being adversely affected by human activity, forest management practices may be adapted to protect water values.

NEW ZEALAND'S REPORT

No detailed quantitative national information is available to identify changes in physical, chemical or biological properties of water bodies that flow through New Zealand's forest lands.

The Ministry for the Environment (2013) reports that river condition indicators monitored nationally (but not by land use) were either stable or improving at most sites. The exception was nitrate concentrations that were increasing in about a quarter of the sites.

The National River Water Quality Network consists of 77 sites on 35 rivers distributed across New Zealand. Monitoring a range of physical and chemical variables has been undertaken since 1989. National trends for the period 1989 to 2007 (but not by land use) showed no significant change in water temperature and percentage of dissolved oxygen, but significant increases in visual clarity, dissolved reactive phosphorus, total phosphorus, oxidised nitrogen and total nitrogen.

Davies-Colley (2013) notes that, compared with Europe, North America and Asia, river water quality in New Zealand is "fairly good", although conditions vary greatly from place to place depending on land use. The author also notes that:

- water quality is very good in rivers draining conservation lands (most of which have indigenous vegetation cover);
- rivers draining plantation forests sometimes approach the quality of rivers in indigenous vegetation cover, although periodic harvest operations can mobilise fine sediment.

Larned et al (2004) assessed water quality at the national level in low-elevation streams by land cover types. Pair-wise comparisons indicated that:

- nitrogen oxide, ammonium and *Escherichia coli* concentrations were significantly lower, and clarity was significantly higher, in indigenous and plantation forest classes compared with urban and pastoral classes;
- differences between indigenous and plantation forest classes were not statistically significant for any parameters;
- the median *E. coli* concentration in indigenous forest streams, and conductivity in plantation forest streams, exceeded the guideline values.

The majority of indigenous forests are located in higher-altitude catchments, and most properties of their water bodies have not been significantly

affected by human activities. However, the historical introduction of browsing animal pests has adversely impacted on the health of some forests, leading to accelerated soil erosion and sedimentation in streams (O'Loughlin, 2005).

For water bodies in plantation forests, the most serious changes that have been measured in water quality are increases in suspended sediment concentration. These increases are associated with the construction of forest roads, tracks and landings for harvesting; accelerated landsliding; and other forms of erosion after harvesting from steep, unstable slopes (Fahey et al, 2003 in O'Loughlin, 2005).

An analysis of the River Environment Classification (Ministry for the Environment, 2014), and the Land Resource Inventory (Landcare Research, 2014), enables estimates to be made of the distances of rivers flowing across forested land areas against the degree of surrounding land soil erosion. This provides one indication of the potential for sedimentation (see Table 4.3).

At the sub-national level, regional councils collect and hold a large amount of water resource information. This substantial resource is used for monitoring, planning and reporting activities (including forestry) that relate to water resources. Land and Water Aotearoa has used models to estimate nutrient concentrations for different land uses based on data collected from hundreds of regional monitoring sites over the five years to 2012.

Sources of information

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Ministry for the Environment (2014). *River environment classification*. **https://www.mfe.govt.nz/environmental-reporting/about-environmental-reporting/classification-systems/fresh-water.html**. Accessed 3 July 2014.

Table 4.3: Distance of rivers within forested areas by degree of surrounding land erosion (kilometres)

Degree of erosion	Indigenous forest		Plantation forest	
	Kilometres	Percent	Kilometres	Percent
Negligible	23 215	26	8 955	43
Slight	47 663	53	8 620	41
Moderate	16 049	18	2522	12
Severe	2 855	3	462	2
Very severe	475	1	153	1
Extreme	217	<1	89	<1
TOTAL stream distance	**90 474**		**20 801**	

Note: The River Environment Classification and the Land Resource Inventory have not been subject to significant updating since the *2009 NZ Country Report*. Consequently Table 4.3 is the same as the corresponding table in the previous report.

Sources: Landcare Research, 2014; Ministry for the Environment, 2014.

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O'Loughlin, CL (2005). Forestry and hydrology. In Colley, M (ed) *Forestry handbook* (4th edition). New Zealand Institute of Forestry (Inc); Christchurch.

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Fiordland, New Zealand.

CRITERION 5:
MAINTENANCE OF FOREST CONTRIBUTION TO GLOBAL CARBON CYCLES

Forests are renewable and one of the largest terrestrial reservoirs of biomass and soil carbon. They have an important role in global carbon cycles as sinks and sources of carbon. Carbon stocks in forests include above ground biomass, below ground biomass, dead and decaying organic matter and soil carbon. Carbon is also stored in wood products.

The biosphere has a significant influence on the chemical composition of the atmosphere. Vegetation draws carbon dioxide (CO_2) from the atmosphere, through photosynthesis, and returns it through respiration and the decay of organic matter. The interchange between the biosphere and atmosphere is large; approximately a seventh of total atmospheric CO_2 passes into vegetation each year.

Global climate change could have significant impacts on the structure, distribution, productivity and health of temperate and boreal forests as well as impacts on forest carbon stocks and fluxes, and the prevalence of forest fires, disease and insect outbreaks, and storm damages.

Forest management practices also affect the carbon cycle and fluxes as well. Deforestation has a negative impact, but management activities that maintain and enhance the carbon stored in forests and forest products over the medium to long term can help to mitigate atmospheric carbon dioxide levels. In addition, biomass from forests (usually wood waste) can be used as a substitute for fossil fuels, thereby reducing their use and displacing greenhouse gas emissions[28].

Change in the global carbon cycle and associated climate change will have major impacts on human wellbeing, especially rural communities and indigenous peoples dependent directly on the natural environment

Table 5.1 lists the indicators covered in this section.

Table 5.1: Indicators for Criterion 5 – quality of information and trends

Criterion 5: Maintenance of forest contribution to global carbon cycles		Quality of information	Trend
5.a	Total forest ecosystem carbon pools and fluxes	H	▲
5.b	Total forest product carbon pools and fluxes	M	▶
5.c	Avoided fossil fuel carbon emissions by using forest biomass for energy	M	▲

28 As the carbon is removed from the atmosphere as the plantation tree grows, emissions from the use of wood as a fuel are balanced over the lifetime of the tree grown.

KEY

L = low	Neutral ▶
M = medium	Positive ▲
H = high	Negative ▼

NEW ZEALAND OVERVIEW

Since 1990 the carbon stock in New Zealand's forests has increased from 3071 million tonnes to a total of 3298 million tonnes in 2012: 2844 million tonnes of carbon in natural forests and 454 million tonnes in the planted production estate.

While still developing data to report on harvested wood product pools, it is possible to infer changes by looking at current domestic production of the key products since 2008:

- carbon in wood being converted into paper declined 13 percent, sawn wood declined 6 percent, and panels declined 5 percent;
- production in 2014 remained 76 percent higher than in 1990;
- woody biomass remained about 7 percent of New Zealand's primary energy in 2013 but energy supply increased by 44 percent to 57.83 petajoules since 2008;
- this has reduced emissions from fossil fuels by approximately 4 million tonnes of CO_2 equivalent, if woody biomass displaced coal.

East coast, New Zealand.

Indicator 5.a Total forest ecosystem carbon pools and fluxes

From 2014 New Zealand started using the Land Use and Carbon Analysis System (LUCAS) for reporting carbon pools and fluxes in all forests. Forest carbon stocks increased from 3071 million tonnes of carbon in 1990 to 3298 million tonnes in 2012. Of this total, 2844 million tonnes of carbon were in indigenous forests and 454 million tonnes were in the plantation production estate.

Quality of information: H

Progress against indicator: ▶

Rationale

This indicator provides information about the total amount of carbon stored in forest ecosystems. It also describes changes, fluxes or flows in carbon between forests and the atmosphere. A better understanding of these processes will aid the development of appropriate responses to the effects of climate change.

NEW ZEALAND'S REPORT

Estimation methodology

Carbon stocks in New Zealand forests are estimated based on three pools defined in the *Good Practice Guidance for Land Use, Land-use Change and Forestry* (IPCC, 2003):

- alive biomass (above ground biomass, below ground biomass);
- dead organic matter (coarse woody debris, fine woody debris and litter);
- soils.

The New Zealand data are being collected through the Land Use and Carbon Analysis System (LUCAS), a robust and comprehensive system for data gathering, management, analysis and reporting that is appropriate for reporting on the land use, land use change and forestry sector under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. Data collection methodologies have been designed to provide unbiased carbon estimates at the national scale, with methods supported by relevant scientific research.

Analysis of the data will provide nationally applicable values for carbon stock and stock change for the three carbon pools, and the key different forest types (indigenous forest versus forests planted for timber purposes, and forests established prior to 1990 and those established after 1989). It also provides information on non-forest land uses.

The areas under different land uses and land use change are based on three wall-to-wall land use maps derived from satellite imagery at nominal mapping dates of 1 January 1990, 1 January 2008 and 31 December 2012. The forest carbon inventory involves the use of plots located on a systematic grid across New Zealand (8-kilometre grid for pre-1990 forests and 4-kilometre grid for post-1989 forests). Recent and historic plots for soil carbon measurement have been established in different land uses.

Plantation forests

New Zealand's exotic plantation forest estate is intensively managed for production forestry, with rapid-growing genotypes selected and enhanced for optimum growth. In 2012, exotic plantation forests covered approximately 2.1 million hectares (gross area) – around 7.8 per cent of New Zealand's total land area. This also includes areas not managed for timber supply; for instance, areas planted for erosion control.

In addition to changes in carbon stock that result from the plantation forest growing into maturity, and their subsequent harvest, land use change is an important driver of the forest carbon stocks. After 2000, New Zealand experienced deforestation in some of its plantation forests (those that were on highly productive agricultural land). This has resulted in a decline in net forest area and a marginal decline in carbon stock when these areas are not replanted (relative to the carbon stock if they had been replanted). Overall, sequestered carbon remains high and increasing.

It is projected that from 2013 onwards, harvesting areas will continue to increase, and around 2020, plantation forest carbon stocks will decline in the short term as the large areas of forests planted (or replanted) in the 1980s and 1990s approach harvestable age. It is expected that these stocks will recover once the forests are replanted. This cyclical change in forest carbon stock is characteristic of New Zealand's non-even age class structure across the whole estate.

A negative number for soil carbon in the post-1989 forests shows that the soil carbon pool under forests is less than that under grassland. It takes 20 years after the conversion for the carbon to stabilise.

Indigenous forest

In 2012 natural forests in New Zealand covered over 7.84 million hectares (as described in Ministry for the Environment, 2014), around 29.1 percent of the land area. This forest is a mix of tall forests and areas of regenerating forests and shrubland that meet the greenhouse gas definition of forest areas (1 hectare in size, over 30 percent canopy cover and 5 metres at maturity)[29]. On average, tall forests that existed prior to 1990 average 253.14 tonnes of carbon per hectare in all biomass pools while shrubland averages 84.88 tonnes of carbon per hectare in all biomass pools (that is, excluding soil).

The long-term change in the carbon stocks within New Zealand's natural forests is less certain primarily due to the difficulty in gathering historical data, and in projecting the recovery of the forests from previous disturbance and the maximum carbon stock that will be reached, which is closely correlated with the species in the mature forests.

29 This total is slightly different than for the natural forest area discussed elsewhere within this report due to slight differences in measurement purposes and definitions of 'forest', which may, for example, include or exclude regeneration of natural forests after 1990.

Sources of information

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Table 5.2: Estimates of the carbon stock in forests at 31 December (million tonnes carbon)

	1990	1995	2000	2005	2010	2012
Indigenous forest						
Living biomass	1 466	1 487	1 507	1 528	1 549	1 557
Dead organic matter	326	327	328	330	331	331
Soil	956	955	955	955	955	955
Total	**2 747**	**2 769**	**2 791**	**2 813**	**2 835**	**2 844**
Pre-1990 plantations						
Living biomass	110	136	153	162	172	170
Dead organic matter	25	32	35	37	39	41
Soil	188	186	184	183	183	183
Total	**324**	**353**	**372**	**382**	**394**	**393**
Post-1989 plantations						
Living biomass	0	0	8	23	47	59
Dead organic matter	0	0	2	8	10	10
Soil	0	–1	–2	–5	–7	–8
Total	**0**	**0**	**8**	**27**	**50**	**61**
ALL FORESTS	**3 071**	**3 122**	**3 170**	**3 222**	**3 279**	**3 298**

Note: Values shown to no decimal places.
Sources: Based on data from Ministry for the Environment, 2014, and unpublished and developing outputs from New Zealand's LUCAS.

and Kyoto Protocol. **http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/sixth-national-communication_20131220%5B1%5D.pdf** Accessed 9 Jul 2015

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Further reading

Ministry for the Environment (undated*). Tracking greenhouse gas emissions.* **http://www.mfe.govt.nz/climate-change/tracking-greenhouse-gas-emissions**. Accessed 10 July 2015.

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Doubtful Sound, Fiordland.

Indicator 5.b Total forest product carbon pools and fluxes

Under the UNFCCC, in April 2015 New Zealand will report emissions and sinks from harvested wood products (HWP). The timing of this *Montreal Process report* means the data to project the HWP stock of wood sourced from New Zealand's forests are still being developed. However, it is possible to infer changes to the HWP pools in New Zealand, and from New Zealand harvested wood that is exported:

- between 2008 and 2014 harvested volume increased 38 percent, with the bulk of this increase in export logs[30];
- carbon in wood being converted into paper declined 13 percent;
- carbon in wood being converted into sawn wood declined 6 percent;
- carbon in wood being converted into panels declined 5 percent;
- production in 2014 remained 76 percent higher than in 1990.

Rationale

This indicator provides information on the role that forest products play in storing, cycling and releasing carbon. Forest products delay the release of carbon into the atmosphere and are more sustainable than products with manufacturing processes that have significant carbon footprints.

30 Year ending 31 March http://www.mpi.govt.nz/Portals/0/Documents/news-resources/statistics/forestry/logs/annual-roundwood-removals.xls

NEW ZEALAND'S REPORT

The UNFCCC has agreed that parties will report the changes in the harvested wood product pool. New Zealand's LUCAS programme has begun to assess the suitability of data to support reporting using the alternative HWP methodologies. In the Agriculture, Forestry and Other Land Uses volume of the revised Intergovernmental Panel on Climate Change (IPCC) guidelines for greenhouse gas inventories (IPCC, 2006), Chapter 4 describes four methodologies for including HWP reporting in national greenhouse gas inventories.

The HWP approaches outlined in the 2006 IPCC guidelines share a common approach of dividing the harvest wood into different product categories based on their lifetimes. All approaches include domestically grown and consumed wood products; they differ in terms of the treatment of imported and exported wood products.

To provide an indication of the carbon that New Zealand can confirm is going into HWP, a proxy measure based on domestically processed wood and the IPCC categories of wood product is provided.

The approach used here loosely approximates the production approach in the IPCC guidelines. Differences include the exclusion of exported roundwood and the disaggregation of the solid wood category into sawn timber and panels. The approach estimates only HWP production and does not provide stock or stock change in the HWP pool. New Zealand is currently developing its HWP reporting methods and full HWP reporting will be provided in the 2013 National Inventory Report (2015 submission). Once New Zealand's HWP reporting methods are complete, it is expected that carbon stock in the HWP pool will increase from 1990 onwards.

As Figure 5.1 shows, domestic processing of harvested wood into short-lived products (paper) has remained relatively static since 1990. In contrast, longer-lived products have increased substantially since 1990, although they have declined since 2005. It is believed that this more recent decline has been driven by relatively high production costs and the high New Zealand dollar, combined with the rationalisation of older, smaller mills.

The fate of New Zealand's exported roundwood is more difficult to determine. While New Zealand's roundwood export has significantly increased since 1990 (from about 17 percent to about 56 percent of the harvest volume), uncertainty exists about the ultimate products these logs are processed into. Work is under way to improve this information: as part of both product traceability work and also for climate change reporting. Therefore export roundwood is excluded from these HWP estimates.

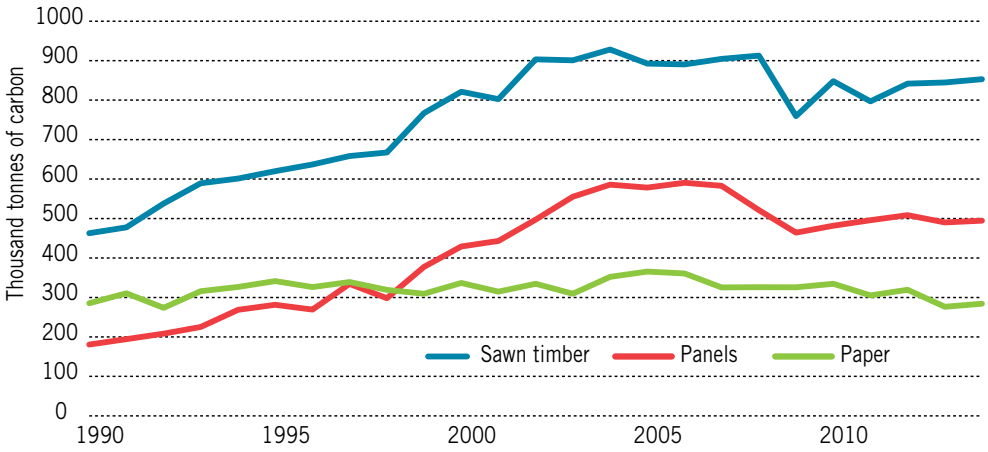
Sources of information

Food and Agriculture Organization (2014). *FAOStat: FAO statistical databases*. Food and Agriculture Organization of the United Nations; Rome. **http://faostat3.fao.org/download/F/FO/E** (modified to enhance data continuity). Accessed 26 May 2015.

Ministry for Primary Industries (2014). *Situation and Outlook for Primary Industries 2014*. **http://mpi.govt.nz/about-mpi/corporate-publications/**. Accessed 9 July 2015.

Intergovernmental Panel on Climate Change (2006). *2006 IPCC guidelines for national greenhouse gas inventories*. Prepared by the National Greenhouse Gas Inventories Programme. Eggleston, HS; Buendia, I; Miwa, K; Ngara, T; Tanabe, K (eds). Institute for Global Environmental Strategies; Japan.

Figure 5.1: Carbon in New Zealand–produced wood processed into the three main wood product categories



Source: Derived from Food and Agriculture Organization, 2014.

Indicator 5.c Avoided fossil fuel carbon emissions by using forest biomass for energy

Woody biomass remains a constant proportion of New Zealand's primary energy but has increased in its energy supplied:

- about 7 percent of the country's primary energy comes from forest biomass, a proportion that has remained since the 2008 report;
- this figure represents 57.83 petajoules, a 44 percent increase since 2008;
- this has reduced emissions from fossil fuels by about 4 million tonnes of CO_2 equivalent, if woody biomass has displaced coals.

Quality of information: M

Progress against indicator: ▲

Rationale

This indicator provides information about the amount of energy produced from forest biomass and the extent to which it offsets the need to burn fossil fuels, thereby benefiting the global carbon budget and lowering carbon emissions.

NEW ZEALAND'S REPORT

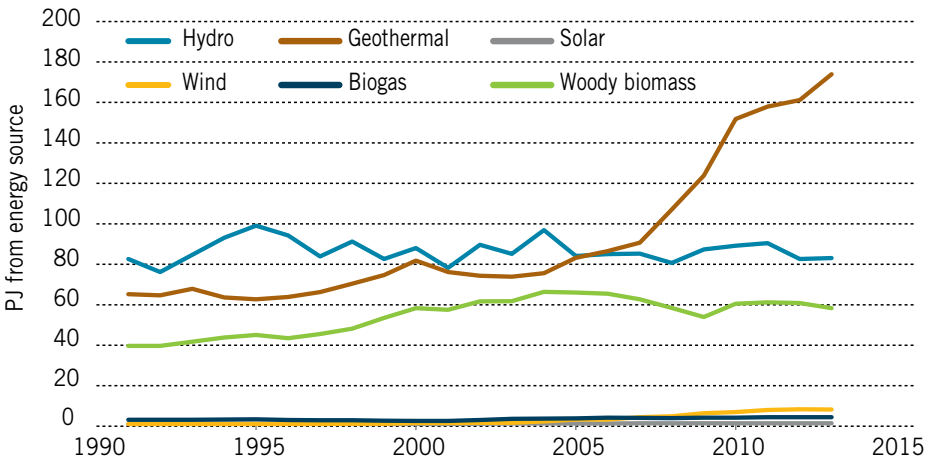
Forest biomass plays a relatively small role in New Zealand's consumer energy supply. While the total energy provided in 2013 has increased by about 44 percent since 2008, strong increases in supply from other sources have meant the percentage of national supply from wood has remained relatively stable at around 7 percent.

Of the 57.8 petajoules of energy supplied from wood, around 4.9 petajoules is used in cogeneration, around 45.6 petajoules in industrial uses and around 7.4 petajoules in residential properties, primarily for heating.

Biomass, usually wood waste, is also supplemented by fossil fuels such as coal and gas. The use of biomass for process heat and electricity generation also has the advantage of reducing waste disposal costs while utilising a renewable resource. Co-firing is used to improve boiler performance when using low-quality primary fuels. In 2013, the Census reported that over 36 percent of New Zealand households use wood to heat their homes.

The use of biomass can be considered as avoiding use of fossil fuels, thereby benefiting the national carbon budget and lowering carbon emissions. However,

Figure 5.2: Energy supply from biomass and other key renewables to the New Zealand's energy supply since 1991



Sources: Ministry of Business, Innovation and Employment, 2014 (Table 2); Ministry of Business, Innovation and Employment, undated: http://www.med.govt.nz/sectorsindustries/energy/energy-modelling/publications/energy-innew-zealand-2014

there are some complexities in calculating avoided emissions. The biomass energy could be replaced by renewable sources (geothermal, wind and hydro) or fossil fuels, hence avoided emission depends on the choice of the energy source.

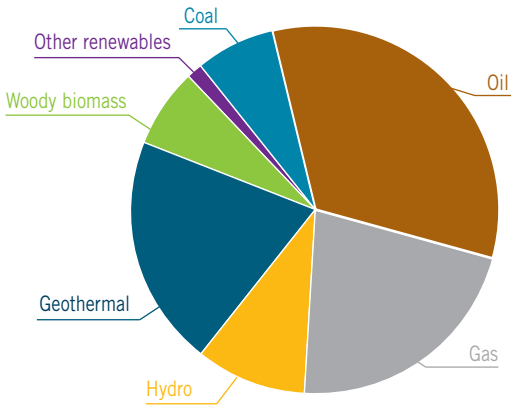
If it is considered that all the current biomass energy used in industrial processes (45.6 petajoules in 2013) was replacing coal, the avoided emission would be about 4 million tonnes of CO_2 equivalent, using an average emission factor of 89.4 kilotonnes of CO_2 equivalent per petajoule.

Sources of information

Ministry of Business, Innovation and Employment (2014). *Energy in New Zealand 2014*. http://www.med.govt.nz/sectors-industries/energy/energy-modelling/publications/energy-in-new-zealand. Accessed 26 May 2015.

Ministry of Business, Innovation and Employment (undated). *Energy in New Zealand: renewables data tables*. http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/energy-data-and-modelling/data/renewables.xls. Accessed 26 May 2015.

Figure 5.3: Breakdown of the New Zealand's consumer energy supply in 2013



Source: Ministry of Business, Innovation and Employment, 2014 (adapted from Table B2).

Central North Island forests.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CRITERION 6:
MAINTENANCE AND ENHANCEMENT OF LONG-TERM MULTIPLE SOCIO-ECONOMIC BENEFITS TO MEET THE NEEDS OF SOCIETY

Forests provide a wide variety of social, cultural and economic goods, services and benefits that contribute to meeting the needs of society. Forests are not distributed uniformly throughout the country but for a number of regions and people who live in them forests and forestry is already the significant or major source of income, livelihood and wellbeing. For a number of other regions and communities forestry is an increasingly important source of local wealth and economic activity. Information on the production and consumption of forest products, investment and employment in the forest sector, forest-based recreation and tourism, and other social and cultural forest values illustrate the many benefits forests provide.

Table 6.1 lists the indicators covered in this section.

Table 6.1: Indicators for Criterion 6 – quality of information and trends

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society		Quality of information	Trend
6.1.a	Value and volume of wood and wood products production, including primary and secondary processing	H	▲
6.1.b	Value of non-wood forest products produced or collected	L	▲
6.1 c	Revenue from forest-based environmental services	L/M	▲
6.1 d	Total and per capita consumption of wood and wood products in roundwood equivalents	M/H	▶
6.1 e	Total and per capita consumption of non-wood forest products	L	▶
6.1 f	Value and volume in roundwood equivalents of exports and imports of wood products	H	▲
6.1 g	Value of exports and imports of non-wood forest products	L/M	▶
6.1 h	Exports as a share of wood and wood products production, and imports as a share of wood and wood products consumption	M	▲ / ▶
6.1 i	Recovery or recycling of forest products as a percent of total forest products consumption	L/M	▼ / ▶
	Investment in the forest sector		
6.2 a	Value of capital investment and annual expenditure in forest management, wood and non-wood forest products industries, forest-based environmental services, recreation and tourism	L/M	▶
6.2 b	Annual investment and expenditure in forest-related research, extension and development, and education	M/L	▶
	Employment and community needs		
6.3 a	Employment in the forest sector	H	▼
6.3 b	Average wage rates, annual average income and annual injury rates in major forest employment categories	H	wages ▲ injury rates ▼
6.3 c	Resilience of forest-dependent communities	L/M	▶
6.3 d	Area and percent of forests used for subsistence purposes	L	▶
6.3.e	Distribution of revenues derived from forest management	L	▲

Criterion 6: Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society		Quality of information	Trend
	Recreation and tourism		
6.4.a	Area and percent of forests available and/or managed for public recreation and tourism	M	▲
6.4.b	Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available	H	▲
	Cultural, social and spiritual needs and values		
6.5.a	Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values	M	▲
6.5.b	The importance of forests to people	M	▶

KEY

L = low
M = medium
H = high

Neutral ▶
Positive ▲
Negative ▼

NEW ZEALAND OVERVIEW

Key findings are:

- Since 2008, there has been little overall change to the "quality" of the available statistical information for reporting against Criterion 6.
- Harvest levels are now 50 percent higher than in 2008, and, as a result, there are upwards trends for a number of the variables, notably those associated with roundwood exports, the share of exports in production, the economic importance of forestry and incomes associated with forestry.
- A notable fact is that virtually all of the increase in harvest has been associated with log exports. Sawn timber and pulp production remain at levels similar to 2008, while paper production is now lower than in 2008.
- Reflecting the growth in harvest, the capital stock in forestry and logging has increased, that associated with solid wood processing remains at levels similar to 2008, while the capital associated with the paper industry has fallen.
- New Zealand remains a relatively high per capita wood user. With relatively slow population growth, and no substantive new use for wood, trends relating to local use of wood products have remained relatively unchanged both in total and per capita terms.
- Sector employment has continued to decline, reflecting increasing labour productivity. The improving injury rates noted in the 2008 report have failed to continue, and the current injury rate is unacceptably high.
- The importance and appreciation of forestry for environmental, recreational, tourism cultural and social purposes have continued to grow. More research is being undertaken to attempt to value these aspects, but at this time quantification of these various values can still only be described as variable.

Forest values

New Zealand's forests are well recognised for a range of natural, cultural, social and economic values, although the relative importance of each value and mixes of values vary with the nature and location of the forests. Māori have strong cultural, spiritual and economic connections with forests and forestry.

The area of tall indigenous forest land in the Crown-owned conservation estate increased from 4.9 million hectares in 2000 to 5.0 million hectares in 2008, and to 5.2 million hectares in 2014 (Earl, 2014). There is, in addition, a further 0.4 million hectares of regenerating indigenous forest administered by the Department of Conservation (DOC) in the public conservation lands. The purpose of management of both the tall and regenerating forest land by DOC is to maintain the intrinsic values.

Commercial forest industries

New Zealand has high quality time series of statistical datasets for the commercial production of wood, processed wood products and trade in wood products. These statistical series now apply essentially to plantation forests, despite indigenous forests accounting for nearly 80 percent of the total estate. Wood harvested from New Zealand's indigenous forests accounts for less than 0.1 percent of the total commercial harvest.

From 2002 to 2008, roundwood removals hovered around 20 million cubic metres per year. The volumes and quantities of processed wood products similarly showed modest increases and decreases over this period, in accordance with market conditions. During the 2002 to 2008 period, log exports fluctuated between 25 percent and 40 percent of total harvest, but typically accounted for about a third of total harvest. Since 2008, both the harvest and the importance of the export log trade, particularly trade with China, have grown dramatically. For the year ended March 2014, the total harvest was 30.3 million cubic metres per year (153 percent of that in 2008). Log exports for the year (17.1 million cubic metres) were 56 percent of the total harvest, and the increase in log exports between 2008 and 2014 (11.1 million cubic metres) was slightly greater than the 10.6 million cubic metre increase in total harvest over this period. As implied by these numbers, the volume of processed products, and specifically the amount of newsprint now produced, is less than in 2008. For most other wood products, current production levels are similar to those recorded in 2008.

Apparent annual domestic consumption of wood and wood products between 2007 and 2014 ranged from 6.7 million cubic metres to just over 9 million cubic metres (roundwood equivalent) per year. Peak consumption over this period (9.02 million cubic metres) occurred in 2008, just before the global financial crisis. The lowest level of consumption (6.74 million cubic metres) was in 2010 (March year). With the gradual improvement of the New Zealand economy since that time, and with rebuilding in Christchurch since the February 2011 earthquake, total consumption has returned to a level of 8.9 million cubic metres per annum (March year 2014). Over the period, annual imports of wood and wood products (in roundwood equivalents) have comprised 30 percent to 38 percent of apparent domestic consumption (assuming all imports are consumed domestically).

At present, nearly 80 percent of the harvested volume is exported as logs or processed wood products. Exports of wood and wood products are worth $5.2 billion (10.5 percent of total merchandise exports) and have increased significantly since 2008 ($3.2 billion), with a 50 percent increase in harvest and a 185 percent increase in the volume of log exports. Over the same period (2008 to 2014), the annual value of imports remained virtually unchanged at $1.5 billion.

Although the commercial forest industries are a significant employer in many regions, and a major employer in a few, the six years between 2007 and 2013 saw a 14.6 percent decrease in direct forestry and first-stage processing employment (from 20 389 to 17 415). Average hourly earnings in both the forest and wood product manufacturing sectors are below the national average, but the gap has narrowed over the past four years, particularly for forestry workers. Average hourly earnings in forestry are currently 84 percent of the national average. For wood product manufacturing, the figure is 85 percent.

Injury prevention and reduction is a critical issue for the sector and for New Zealand's workplace regulators. The injury claim rate for the primary sector (which includes agriculture and fishing as well as forestry) is more than twice the national average, and the forest industry has seen a rise in fatalities in the past few years (reversing a downward trend in the figures from the 1990s and early 2000s). In January 2014, the industry commissioned an independent forestry safety review to identify the causes and factors contributing to the fatalities and rate of serious injury occurring within the sector (*Independent Forestry Safety Review,* 2014). Changes proposed by the Health and Safety Reform Bill, where people conducting a business, task or project (undertaking) will share and own the same duties as the people on the ground, are likely to increase the focus of all parties on health and safety within the forest industries.

With the exception of paper (and paperboard), limited progress has been made in the recycling of wood products. About 30 percent of domestic consumption of paper and paperboard is recycled. Significant volumes of waste timber and other wood products go to landfills.

Non-wood forest products

The economic benefit that New Zealand derives from the forest estate is not just confined to timber. The indigenous and plantation forests are significant attractions for the $23.8 billion tourism and recreation industry, and there is reasonable data on this sector. For other non-wood forest products industries, data are generally limited in their development, often regional in focus and not always specifically forest based, for example, the mānuka honey industry. Because of the small scale (and diversity) of most of these activities, up-to-date information on production, consumption and trade for many non-wood forest products is difficult to obtain.

Environmental services

Forests provide environmental services that support sustainable resource management; such roles are increasingly being acknowledged from parts of the New Zealand community. At the national level carbon sequestration is a key environmental services that are provided by forests. While at the local level water quality and mitigating soil erosion are possibly the most recognised environmental services that forests provide for New Zealand. Two regionally focused government-funded schemes provide grants for tree planting for this purpose: the Erosion Control Funding Programme (East Coast) (previously the East Coast Forestry Project) and the Sustainable Land Management Hill Country Erosion Programme. The New Zealand Emissions Trading Scheme (to be reviewed in late 2015) and the Permanent Forest Sink Initiative provide carbon credits to forest owners for carbon sequestration. These credits can be sold.

Research and development

Total expenditure on research and development (R&D) is difficult to assess because of the number of research providers, the diversity of funding sources and the challenge in defining what is true research expenditure, as opposed to something else such as publicity or marketing. There is also a question of what percentage of any research that is not simply pure forestry, but that does have an acknowledged potential forestry component, should be regarded as being forestry related.

These challenges acknowledged, central government is still clearly the principal source of R&D funding, with the Ministry of Business, Innovation and Employment (MBIE) being the agency that manages and co-ordinates the allocation of the bulk of government research funding. MBIE is also the agency charged with monitoring the effectiveness of public sector investment. A quarter of government R&D expenditure supports the primary industries, which include forestry. Government invested $789.6 million for science and innovation for the 2013/14 year, of which $197.4 million is the estimate of the primary sector's share of this funding. Nearly 18 percent of this, or $35.5 million, is estimated to be directly forest research-related funding. This in turn means forestry research funding represents about 4.5 percent of the science and innovation budget.

In addition, research in areas such as transport, industrial production and energy, which together represent another 30 percent of all government R&D expenditure, has associated benefits to forestry.

Despite the focus on government, not all R&D expenditure is government funded. Research funding from the forest growers levy is managed and directed by the Forest Growers Levy Trust, a statutorily endorsed forest industry organisation, while individual forestry-related businesses also undertake or commission research specifically tailored to their own interests and needs.

Sources of information

Earl, R (2014.) Personal communication. Department of Conservation; Wellington.

Independent Forestry Safety Review (2014). *Factors influencing health and safety in the forestry sector – public consultation document*. Independent Forestry Safety Review; Wellington.

INDICATOR 6.1 PRODUCTION AND CONSUMPTION

These indicators provide information on the contribution of wood and non-wood products and environmental services to national economies. The value, volume and revenues associated with domestic production and consumption of forest products and services, including through international trade, demonstrates the type and magnitude of the contribution of forests to domestic economies. They also provide information about market conditions relevant to forest management and the forest sector.

Indicator 6.1.a Value and volume of wood and wood products production, including primary and secondary processing

New Zealand has readily available, high quality time series of statistical data on the production and trade of harvested wood and wood products. The annual values and volumes of wood and wood products vary with market conditions. National accounts provide information on the industries' financial contributions to the country's economy.

Quality of information: H

Progress against indicator: ▲

Rationale

This indicator provides information on the value and volume of wood and wood products at various stages of processing. The value and volume of wood products reflects one aspect of the importance of forests and wood processing sector to the domestic economy.

NEW ZEALAND'S REPORT

New Zealand can estimate the contribution from commercial forest industries in terms of value to the economy or to New Zealand's gross domestic product (GDP) through the "Forestry and logging" and "Wood and paper products" production groups in the New Zealand System of National Accounts. The units of value are New Zealand dollars for the relevant year, or (for a time series) constant 1995/96 prices. The value added through downstream processing is estimated and/or captured as the contribution to GDP of the production groups "Wood and wood products" and two-thirds of the value of the "Paper, printing and publishing" group.

Table 6.2 illustrates the type of data that are available for value estimates, in this example, in constant 1995/96 prices. This means the changes in the value shown reflect changes in the volume of output.

Table 6.2: Forest industries' contribution to GDP (2006–2014) expressed in 1995/96 prices ($ million calendar year)

Industry group	Forestry and logging		Wood and paper products		GDP
Year	$ million	% of GDP	$ million	% of GDP	
2006	1 144	1	2 518	2	133 854
2007	1 214	1	2 485	2	137 592
2008	1 238	1	2 472	2	141 560
2009	1 177	1	2 196	2	138 841
2010	1 298	1	2 285	2	138 690
2011	1 423	1	2 403	2	141 208
2012	1 459	1	2 415	2	144 596
2013	1 535	1	2 313	2	147 917

Note: GDP = gross domestic product.
Source: Statistics New Zealand, 2014.

A similar table in dollars for the year would reflect the value changes due to both price and output quantity changes. The volumes of output from forests (roundwood removals) are provided in Table 6.3, and outputs from the sawmilling, panel products, pulp and paper, and log and chip export industries are provided in Table 6.4.

More detailed data, both quarterly and annual, relating to production of major forestry products are available on the websites of the Ministry for Primary Industries or Statistics New Zealand – see **www.mpi.govt.nz** or **www.statsnz.govt.nz.**

Sources of information

Ministry for Primary Industries (2014). *Forestry: forestry production and trade statistics detail the production, trade, and other forestry activities in New Zealand*. **http://www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/forestry/**. Accessed 5 May 2015.

Statistics New Zealand (2014). *Gross domestic product by industry*. **www.stats.govt.nz/browse_for_stats/economic_indicators/GDP/GrossDomesticProduct_HOTPDec13qtr.aspx**. Accessed 5 May 2015.

Table 6.3: Estimated roundwood removals from New Zealand forests (000 cubic metres of roundwood) (2005–2014)

Year ended March	Indigenous forest total	Plantation forests							Total removals
		Saw logs	Peeler logs	Small logs	Pulp logs	Export chip	Export logs	Plantation total	
2005	27	8 013	1 169	1 486	3 286	199	5 123	19 277	19 303
2006	23	7 641	1 120	1 479	3 234	261	5 067	18 802	18 825
2007	18	7 768	1 198	1 409	3 284	265	5 973	19 897	19 915
2008	18	7 839	1 204	1 290	3 492	363	6 199	20 388	20 406
2009	16	6 519	1 084	1 184	3 119	293	6 648	18 847	18 863
2010	14	6 675	784	1 180	3 461	276	9 567	21 944	21 958
2011	17	7 172	1 156	1 028	3 681	317	11 679	25 033	25 050
2012	16	6 937	1 215	1 254	3 582	451	12 531	25 971	25 987
2013	15	7 169	1 075	1 278	3 495	363	14 678	28 057	28 072
2014	22	7 322	1 077	1 234	3 433	256	17 083	30 405	30 427

Source: Ministry for Primary Industries, 2014.

Table 6.4: Annual production volumes: quantities by forest industries (2005–2014)

Year ended March	Sawn timber (000 m^3)	Panel products (000 m^3)	Pulp (000 air dried tonnes)	Paper and paperboard (000 tonnes)	Log and chip exports (000 m^3 roundwood equivalent
2005	4 392	2 179	1 587	921	5 323
2006	4 235	2 214	1 561	941	5 328
2007	4 301	2 203	1 529	872	6 238
2008	4 340	1 939	1 546	871	6 562
2009	3 609	1 716	1 511	870	6 942
2010	3 695	1 521	1 537	897	9 843
2011	3 971	1 873	1 590	930	11 997
2012	3 840	1 947	1 555	859	12 938
2013	3 968	1 880	1 495	825	15 014
2014	4 057	1 880	1 468	749	17 339

Source: Ministry for Primary Industries, 2014.

Indicator 6.1.b Value of non-wood forest products produced or collected

The economic benefits that New Zealand derives from the forest estate are not confined to timber production. New Zealand's indigenous and plantation forests are important components of the $23.8 billion tourism and recreation industry. Nature-based tourism activities are among the principal attractions for overseas visitors, and an increasing number of communities are coming to rely on the employment generated by this sector.

A number of small to medium scale industries also rely upon the forest estate. These include the beekeeping industry, which produces several monofloral honeys based upon tree species; the game hunting and trapping industry; and the sphagnum moss collection industry. While these industries are not major employers at the national scale, they are important for supporting economic activity within local communities.

Rationale

This indicator provides information on the value of non-wood forest products. The collection, processing and use of non-wood forest products are important dimensions of the economic value of forests. In some countries, non-wood forest products are vital to the livelihoods and lifestyles of indigenous and other rural communities.

NEW ZEALAND'S REPORT

Timber production is just one of the economic benefits that New Zealand derives from its indigenous and plantation forest. The 10.1 million hectare forest estate is a significant component of New Zealand's tourism industry. The tourism industry is one of the economic drivers of the economy, particularly in rural and more remote areas. The industry directly contributed $8.3 billion (or 4.0 percent) to gross domestic product (GDP) in the March 2014 year and a further $6.5 billion of indirect value added (equal to 3.2 percent of GDP)[31]. At an employment level, the tourism industry directly employed 4.7 percent of the working population in the March 2014 year (Statistics New Zealand, 2014). This equated to 94 100 full-time equivalent (FTE) positions.

Another industry with a strong reliance on New Zealand's forests and bush lands is apiculture. The forest estate is an important source of pollen and nectar for apiarists. Several monofloral honeys are sourced from forest and bush lands. Honey exports have grown strongly over the past decade, and this has generated increased interest in the opportunities provided by the forest estate.

New Zealand's indigenous and plantation forests have also been used over the past century for commercial game and trophy hunting, possum trapping (for fur and skins) and sphagnum moss collection. These activities employ relatively small numbers but can be important in local communities. A range of medicinal herbs and berries have traditionally been collected by Māori and the early European settlers. These resources have mainly been gathered for personal use, but are attracting increasing commercial interest for health and skin-care products. For the future, research and commercial trials are under way on the establishment of secondary crops in plantation estates (such as mycorrhizal mushrooms). The intention is to diversify production and improve the economic returns from forestry.

Value of recreational tourism

> Natural attractions are widely regarded as New Zealand's key draw-card for international visitors… Nature-based tourism ranges from high impact adventure activities such as jet boating, skydiving and mountain climbing to more relaxing activities such as bush walking, wild life and scenic tours. (Ministry of Tourism, August, 2009, p 1).

31 The gross domestic product figures calculate the value added contributed by tourism (directly and indirectly). The figures exclude imports sold to tourists.

In 2009, the Ministry of Tourism[32] estimated that around 70 percent of international visitors participated in at least one nature-based tourist activity, while the "propensity for domestic tourists was lower at around 22%, owing to a higher proportion of visitors being on business or visiting friends and relatives" (Ministry of Tourism, August 2009, p 1). Nature-based activities that attracted between 200 000 and 500 000 overseas visitors in 2008 included short and half-day bush walks, glacier walks, trekking, visiting national parks and lakes, scenic drives and geothermal attractions.

Total tourism and recreational spending amounted to $23.8 billion in the March 2014 year, of which international visitors contributed $10.3 billion and domestic visitors $13.4 billion. Total tourism expenditure increased 77 percent (in nominal terms) in the 15 years from 1999. In 1999, tourism expenditure stood at $13.4 billion. This figure increased steadily during the early 2000s and reached $22.1 billion in 2008. (Statistics New Zealand, 2014).

The growth in tourism expenditure over the past 15 years has been driven by overseas visitor numbers. Short-stay visitor numbers have climbed 81 percent over this period, from 1.52 million in the March 1999 year to 2.75 million in the March 2014 year, as shown in Figure 6.1 (Statistics New Zealand, Infoshare, 2014).

32 The Ministry of Tourism is now part of the Ministry of Business, Innovation and Employment.

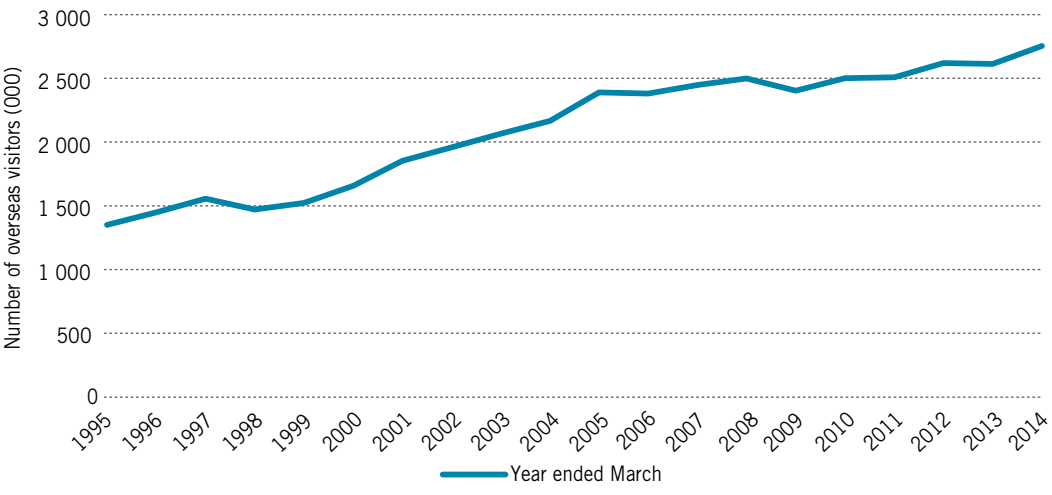
Direct employment in tourism was estimated to be 94 100 FTEs, in the March 2014 year. Another 72 700 FTEs were generated through indirect activities. (Statistics New Zealand, 2014, p 33).

The importance of recreational tourism can be seen particularly in regions such as the West Coast of the South Island that continue to rely heavily on their natural resources. The region has extensive areas of indigenous forest, which have been incorporated into the conservation estate. A study by the Department of Conservation (DOC) found that the economic activities associated with the public conservation estate contributed "15 percent of the 12,341 full-time job equivalents in the region in 2003, 13 percent of total household income, and more than 10 percent of total gross output" (Department of Conservation, 2006, p 7). Most of these activities are related to tourism and recreation, followed by mining and farming. The activities are mainly conducted by third parties through a formal concession system. This system enables DOC to monitor the use of the West Coast's natural resources and ensure they are being managed in a sustainable manner. In 2003, there were 682 third-party concessions on the West Coast for non-mining activities. The economic activity on conservation lands generated value-added of $117.7 million in 2003 and total output of $221.6 million (Department of Conservation, 2006).

Honey production and related products

As discussed in indicators 2.e and 6.1.g, the forest estate is an important source of pollen and

Figure 6.1: Overseas visitor arrivals to New Zealand (1996–2014)



Source: Statistics New Zealand, Infoshare, 2014

nectar for apiarists. Several indigenous tree species have been identified as having favourable traits for honey production, and a range of monofloral honeys have been developed. These include mānuka *(Leptospermum scoparium),* southern rātā *(Metrosideros umbellata)* and tāwari *(Ixerba brexiodes)*. Mānuka honey is particularly favoured as it contains a number of natural compounds with recognised antibacterial properties, which enable it to be used in medical dressings and for treating burns.

Nationally, New Zealand produced 17 825 tonnes of honey in the 2012/13 season (Ministry for Primary Industries, 2013). Estimating the proportion of honey derived from forests and pasture species would be difficult because apiarists frequently move their hives into forested areas or locate them on the bush line in early spring, so they can access nutrients from the bush. Indigenous forests provide the hives with an early season nectar flow that is critical for building up bee colonies.

Honey exports have been growing progressively over the past decade and reached 8000 tonnes in the 2012/13 season. As discussed in Indicator 6.1.g, the value of honey exports was $170.5 million in the December 2013 year. The industry also produces a range of secondary products, for both the domestic and export market. These include: beeswax, live bees and queen bees.

Possum fibre and related products

The past 15 years has seen renewed commercial interest in the trapping of the Australian brushtailed possum *(Trichosurus vulpecula)*. Originally introduced with the objective of building a fur trade in New Zealand, the possum population expanded rapidly (due to a lack of predators) and is now estimated to be 30.3 million (Warburton et al, 2009). The species is a significant threat to New Zealand's native flora and fauna.

The revival in trapping stems from consumer interest in the inherent thermal qualities of possum fibre and new manufacturing techniques that enable possum fibre to be blended with merino wool, to create a light-weight, high-quality yarn.

As discussed in Indicator 2.e and 6.1.g, this fibre blend has become an established part of the yarn and high-quality fashion industry. In 2008, the merino–possum yarn and fashion sector was estimated to be worth $50 to $70 million per annum, and a 2010 estimate put turnover at $100 million per annum (Adams, 2010; Warburton, 2008).

A small trade in fur skins continues and there is also interest in possum meat as a high-quality pet food.

Game meat

Commercial and private hunters have sourced game meat from New Zealand's forested areas for more than a century. As outlined in Indicator 2.e, commercial hunters harvested between 10 000 and 30 000 feral deer per annum during the 1990s and the early 2000s. Numbers fell away in 2002 and 2003, with a fall in venison prices and a tightening of export controls. Commercial hunting remains at relatively low levels and could be described as a niche industry. In 2012, four processing companies handled most of the feral deer that were commercially hunted.

Recreational hunting remains a significant activity. Research by Lincoln University estimates that "there are in the order of 40,000 or more game hunters, who spend about 1.3 million days per year hunting" (Kerr, 2012, p 3).

Guided hunting

New Zealand has developed an international reputation as a destination for game hunting. The industry has developed over the past 20-to-25 years, and now includes a number of game estates and reserves (large fenced areas of indigenous forest, non-forest trees and vegetation and open grasslands), where selected stock are introduced. Game estates can be well over 2000 hectares in size, and are comparable to open range hunting. Hunters are attracted by New Zealand's wilderness experiences and the range of species that can be hunted. These include chamois, red and sika deer, tahr and wapiti.

All of these species have been introduced over the past 150 years and have established in New Zealand's forest and conservation lands.

> The costs of hunting on a game estate vary depending on the client's aspirations. It can range from $200 [NZ] for a hind to $10 000 [NZ] for a top trophy, with the average being $2000 to $3000 (Orman, 2006, pp 8–9).

Earnings from the game estate and guided hunting industry were estimated to be worth $15 million to $20 million per annum in the 2000 to 2005 period (Earl, 2001; McKinnon, 2006). More recent estimates of earnings are in the vicinity of $25 million per annum. In 2013, the Game Animal Council Act established the Game Animal Council, which has a range of functions in relation to game animals including the improvement of hunting opportunities and setting minimum standards for hunting guides and estates.

In addition to commercial game hunting, New Zealand receives substantial numbers of visitors who hunt with friends and family, or who arrange their own hunting permits. While these visitors are not recorded in the game industry financial estimates, they do contribute to local economic activity through expenditure on accommodation and other services.

Sphagnum moss collection

A regionally important activity for the West Coast of the South Island has been the collection of sphagnum moss *(Sphagnum cristatum)* (see Indicator 2.e). A large percentage of this crop is exported to Japan and Southeast Asia, where the principal customers are orchid growers. Exports during the 1990s ranged between $13 million and $18 million per annum but have declined in the past decade. Exports fell to $9 million in the June 2007 year and have been in the range of $3.9 million to $4.5 million since 2011 (Plant and Food Research, 2013).

Future crops

Several innovative research and investment efforts are under way to commercialise the extraction of native plant extracts for food ingredients, medicinal purposes and skin-care products, and to extend the range of secondary crops that can be grown within the forest estate. Indicator 2.e provides details on the prospects for these new opportunities.

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Indicator 6.1.c Revenue from forest-based environmental services

New Zealand's forests provide a broad range of environmental services that benefit both local communities and the national economy. These services include erosion mitigation, the filtering of nutrients, the protection and enhancement of biodiversity, carbon sequestration and recreational health benefits. While New Zealanders place a high priority on these services, they have generally been treated as free or public goods. The exceptions to this have been targeted initiatives for catchment management (for erosion and flood protection) and the introduction of the New Zealand Emissions Trading Scheme (which provides tradable carbon credits).

Within New Zealand, debate is growing on environmental services (frequently referred to as ecosystem services) and how New Zealand can maintain its natural capital through policy actions and initiatives. This dialogue has been supported by an increasing body of research on the value of non-market services from New Zealand's natural resources and the primary sector. This work is increasing community and political awareness of these issues, particularly in the context of soil and water management.

Rationale

This indicator provides information about forest-based environmental services for which markets and revenues are emerging or currently exist. Revenues from forest-based environmental services can be an important component of the economic value of forests.

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Mitigation of soil erosion

> The benefits provided by erosion control are a key ecosystem service in New Zealand because of the widespread occurrence of many different forms of erosion. (Basher, 2013, p 363)

New Zealand has naturally high rates of erosion, which are compounded by extreme weather events. "Hill country erosion is estimated to cost New Zealand between $100 and $150 million per year" (Dominati and MacKay, 2013, p 1) through lost production, damage to infrastructure and sedimentation. One of the most effective measures for maintaining soil cover and fertility on properties is to utilise forest and shrub cover.

> Storm damage surveys since 1970 show that the area of soil eroded by storms is consistently less where forest is planted, scrub is allowed to revert or bush is retained, than under pasture. Reductions are mostly in the range of 50% to 90%. (Blaschke et al, 2008, p 63)

Erosion management has been a public policy issue for over 80 years, and there have been several programmes to support landowners to modify their land use practices (particularly on hill country properties). Regional councils have continued this work and are engaging with landowners and communities in vulnerable catchments. Central government has put in place several targeted programmes for erosion control:

- The Erosion Control Funding Programme (ECFP) (previously the East Coast Forestry Project) was initiated in 1992. The programme targets severely eroded properties with high sediment yields in the Gisborne (East Coast) region of the North Island. The ECFP uses grants to establish plantations and wide spaced plantings and encourage the reversion of land to indigenous forest. In 2014, about 42 000 hectares have been treated.
- The Sustainable Land Management Hill Country Erosion Programme was introduced in 2006/07. This initiative is a partnership between central government and regional councils to support hill country farmers in treating soil erosion through sustainable land management practices. Management tools include whole farm plans, the use of forestry or wide spaced plantings and land

retirement (through natural reversion to indigenous forest).

These programmes recognise that avoiding erosion has significant, long-term benefits for the productive capacity of New Zealand's pastoral and forest lands, through improving water quality and protecting the "built environment" in rural and urban communities. (See Indicator 4.1.a.)

Carbon sequestration and emissions trading

The Government operates the New Zealand Emissions Trading Scheme (ETS) to help meet its international climate change obligations and help reduce New Zealand's net greenhouse gas emissions to below business-as-usual levels. The key sectors of the economy are being progressively brought into the scheme, and market mechanisms set the price of tradable carbon units.

The forestry sector entered the ETS in January 2008, and owners of post-1989 forests (on eligible land) have been able to register their holdings and account for changes in the carbon stocks of their forests since this date. The ETS recognises the ability of forests to sequester carbon dioxide from the atmosphere and store it in branches, tree trunks, leaves, roots and the soil. At the time of harvest, owners repay an equivalent number of units to the carbon that has been lost through harvesting.

This mechanism recognises the important role that new forests (those established after 1989) play in sequestering carbon (and offsetting emissions in other sectors). These forests are around a third of the current plantation estate, and future plantings will add to this total. While the forest owner has to repay the carbon credits, they may gain cash flow by trading carbon credits throughout the rotation. This additional revenue has operational advantages (in terms of matching expenditure to income) and reduces the effective holding costs of investors. Managing carbon sequestration credits accrued in multi-aged forests also enables forest owners to balance harvesting emissions with sequestration gains in younger stands, adding real value to forest holdings.

In the initial years of the scheme, trading saw a carbon price of around $20.00 per New Zealand unit tonne of carbon dioxide equivalent). However, over the past three years (2012–2014), there has been significant price volatility and a decline in overall price. As of mid-2014, the price of a New Zealand unit was around NZ$4.00.

Research undertaken by Patterson and Cole (2013) ranked climate change regulation as the third most valuable ecosystem function performed by forests in New Zealand.

Other initiatives

In 1977, the Government established the Queen Elizabeth II National Trust to protect significant natural and cultural features on private land, using open space covenants. The Trust acts as a perpetual trustee to ensure the covenanted areas remain protected. These areas include wildlife habitats, remnants of natural forest, cultural sites and grasslands. The Trust provides legal and management assistance to landowners in establishing the covenanted areas. Financial assistance may also be available to partially fund fencing costs and similar work. As at 30 June 2014, 180 845 hectares were protected through 4350 registered or approved covenants.

In 2007, the Government approved the Afforestation Grant Scheme (AGS), which ran for five years (from 2008/09). The AGS was part of the Government's package of climate change initiatives and had the twin objectives of increasing carbon sequestration and enhancing land use sustainability. The criteria for assessing applications had a weighting towards applications that could show tangible benefits for soil conservation, improved water quality and enhanced biodiversity. The AGS was of particular benefit to hill country farmers, who were seeking to use plantings as both an economic investment and as a tool to manage soil and water issues.

Environmental services: A developing area of public debate

The role of environmental services is emerging as an important planning and policy issue in New Zealand. Government agencies, such as the Department of Conservation and Ministry for the Environment, are taking on board the need to accurately assess New Zealand's natural capital, and to develop valuation methods that can measure non-market goods and services.

> The first steps in preventing further decline in ecosystems (and the services they provide) are to recognise that they have economic values, and to attempt to measure at least some of

> them. Armed with this information, the Department [of Conservation] hopes to make better-informed conservation decisions, and increase public awareness of what is at stake… (Department of Conservation, 2006, p 19)

The development of base-line environmental data is occurring at both a local and national level, with councils, government agencies and key industry groups exploring methodologies for valuing the benefits of ecosystems. In recent years, choice modelling and contingent valuation methods have been used to value biodiversity, water quality enhancement and recreational values. The direction of this analysis is illustrated in a 2006 study of the water supply services provided by the 22 000 hectare Te Papanui Conservation Park, near Dunedin in the South Island.

> In approaching a valuation of Te Papanui's water supply, Butcher Partners Ltd asked this question: if the water supply were suddenly removed, how much would it cost the biggest users to get water from somewhere else?
>
> The resulting value of the water supply was $11 million a year (in 2005 dollars) to provide water for Dunedin residents, hydro-electricity generators in the region, and to irrigate the fields of Taieri farmers. This figure equates to a one-off payment in 2005 of $136 million. (Department of Conservation, 2006, p 13)

The need for this type of work is also being recognised by commercial enterprises and community organisations. Several project assessments have been undertaken in recent years that have incorporated non-market environmental services as part of their analysis. As the New Zealand public becomes more familiar with this type of assessment, environmental values are likely to play a larger role in negotiations on resource management issues.

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Indicator 6.1.d Total and per capita consumption of wood and wood products in roundwood equivalents

Consumption of wood products is estimated using import, exports and production data. Total apparent consumption, and apparent consumption per 1000 capita, have been slowly trending down, with minor year-on-year variation during the period from 2007 to 2012 reflecting general economic conditions applying at the time. For 2014, the total consumption and consumption per 1000 capita increased to 8.9 million and 1975 cubic metres respectively.

Quality of information: M/H

Progress against indicator: ▶

Rationale

This indicator provides information on consumption, including consumption per capita, of wood and wood products. It provides an indication of trends and changes in wood usage within New Zealand and illustrates one aspect of society's dependence on forests as a source of raw materials.

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The indicator can be interpreted as apparent domestic consumption of various and/or all wood and wood products. Conceptually, this is measured as: Apparent domestic consumption = reported production + (reported imports – exports) + changes in stocks. (It should be noted that, in general, in the New Zealand reporting, no allowance is made for stock changes.)

Consumption per 1000 capita equals apparent gross domestic consumption in the reference period divided by estimated mean population (in 1000s) for the same reference period. Table 6.5 provides figures for 2004 to 2014 for domestic consumption of roundwood.

Apparent domestic consumption and per capita consumption data are available for a range of wood and wood products. The products for which MPI reports apparent consumption are: roundwood, sawn timber, wood pulp, paper and paperboard, plywood, particleboard and fibreboard. An example of the available time series information (for sawn timber) is given in Table 6.6.

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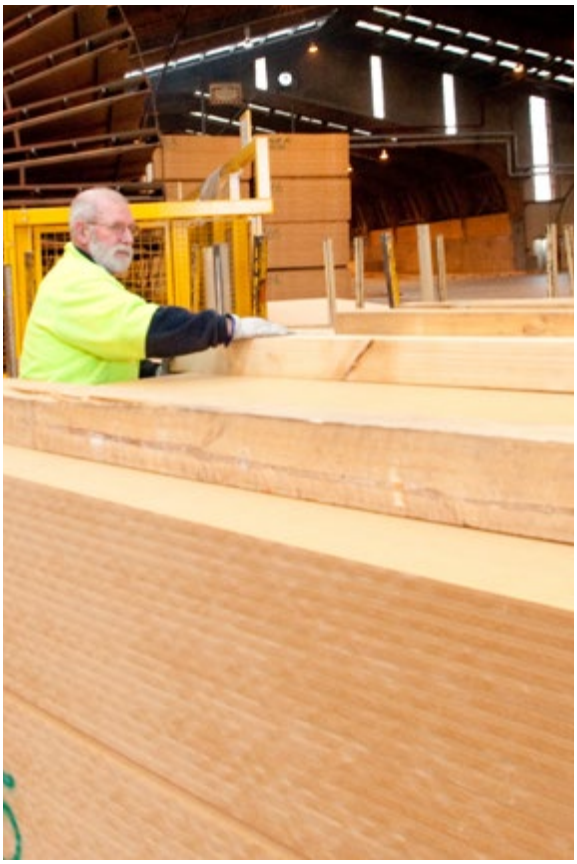

Table 6.5: Estimated domestic consumption of roundwood (2004–2014)

Year ended March	Mean NZ[1] population (000)	Production (000m³)	Imports[2] (000 m³)	Exports[3] (000 m³)	Total apparent consumption (000 m³)	Apparent consumption per 000 capita (m³)	Consumption per 000 capita (5-year moving average) (m³)
2004	4 045	20 910	2 330	14 590	8 650	2 138	2 024
2005	4 101	19 333	2 410	13 458	8 254	2 020	2 045
2006	4 148	18 896	2 507	13 616	7 787	1 877	2 016
2007	4 198	19 974	2 478	13 979	8 473	2 018	2 026
2008[4]	4 241	20 481	2 755	14 213	9 023	2 127	2 036
2009[4]	4 281	18 937	2 373	14 434	6 876	1 606	1 930
2010[4]	4 332	22 042	2 153	17 460	6 735	1 555	1 837
2011	4 381	25 131	2 437	19 796	7 772	1 774	1 816
2012[4]	4 415	26 070	2 469	20 707	7 832	1 774	1 767
2013[4]	4 444	28 164	2 377	22 970	7 570	1 704	1 682
2014	4 489	30 258	3 384	24 776	8 866	1 975	1 756

Notes: 1. Estimated resident populations from 2001–06 have been revised in light of results from the 2006 Census.
2. Imports do not take account of the use of sawmill residues in the country of origin.
3. Exports are adjusted to net roundwood to account for the use of sawmill residues.
4. Includes an estimate – newsprint exports estimated because data withheld by Statistics New Zealand for confidentiality reasons.
5. This table updates Table D8 of New Zealand Forestry Statistics 2000, Ministry of Agriculture and Forestry (2001).
6. No account is taken of changes in stock levels.

Source: Ministry for Primary Industries, 2014a.

Table 6.6: Estimated production, imports, exports and consumption of sawn timber (2004–2014)

Year ended March	Mean NZ population (000)	Production (000 m³)	Imports (000 m³)	Exports (000 m³)	Total apparent consumption (000 m³)	Annual consumption per 000 capita (m³)	Consumption per 000 capita (5-year moving average) (m³)
2004	4 045	4 222	42	1 624	2 640	653	627
2005	4 101	4 409	50	1 847	2 612	637	627
2006	4 148	4 273	58	1 818	2 512	606	626
2007	4 198	4 333	51	1 938	2 446	583	627
2008	4 241	4 382	56	1 771	2 666	629	621
2009	4 281	3 651	42	1 739	1 953	456	582
2010	4 332	3 742	38	1 916	1 864	430	541
2011	4 381	4 016	41	2 053	2 004	457	511
2012	4 415	3 886	44	1 928	1 994	452	485
2013	4 444	4 019	44	2 117	1 946	426	447
2014	4 489	3 936	325	2 024	2 238	498	455

Notes: See under Table 6.5.
Source: Ministry for Primary Industries, 2014b.

Indicator 6.1.e Total and per capita consumption of non-wood forest products

New Zealand's forest estate provides opportunities for game meat, possum fur, honey and herbs, but the harvest levels are limited and there is a low reliance on this resource by individuals and households.

The hunting of feral deer, goats and pigs is a popular past time for a section of the community, but the meat represents only a small proportion of the protein intake of the New Zealand population. Households have some reliance on the forest estate for honey. On average, New Zealanders consume about 1 kilogram of honey per annum. New Zealand's forests were traditionally used by the Māori population as a source of berries, herbs and nuts. Some harvesting of berries and herbs continues. The harvest levels are considered to be small, although interest in the use of traditional foods and medicines, for private and commercial use, is growing.

The forest estate supports a small sphagnum moss industry but most of this harvest is destined for overseas markets rather than domestic consumption. This is also the case for the possum trapping industry. The fur and skins are used in high-value fashion garments, which are primarily exported or sold to international visitors. A recently developed merino–possum yarn is generating increased domestic interest in possum fibre, and it is becoming common to see these garments in local retail stores.

Rationale

This indicator provides information on the consumption of non-wood forest products. The quantity of non-wood products consumed illustrates society's dependence on forests as a source of these products.

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Limited statistical information exists on the consumption of non-wood forest products in New Zealand, particularly game meat and wild foods, as they are normally harvested for personal use.

> Whilst [the New Zealand Food Safety Authority] is reasonably confident that it knows the range of wild foods that are harvested, there is a lack of reliable and up to date information on harvesting activities. (NZFSA, 2007, p 15).

Some secondary information is available through hunting organisations, nutritional studies and the companies that process game meat and wild foods. This information indicates that wild foods are a small component of most New Zealanders diet. In saying this, it is important to recognise that, for a section of the Māori population, the collection of wild foods (from the forest and marine environment) continues to be a high priority.

Game meat consumption

The principal game animals harvested in New Zealand are deer, goats (including chamois and tahr), pigs and rabbits. Each of these species was introduced to New Zealand for their meat and hides. They have become established across the country, and their grazing patterns pose a threat to the natural ecosystems in which they now roam.

Of the seven deer species established in New Zealand, red deer are the most commonly hunted, followed by Sika deer and fallow deer. A limited number of surveys have been conducted on the number of deer harvested by recreational hunters. Work in the early 1990s estimated that the annual harvest (using ground-based hunting techniques) was roughly 50 000 head per annum (NZFSA, 2005). Anecdotal evidence from the New Zealand Deerstalkers' Association indicates that "90% of what is hunted ends up on the table" (NZFSA, 2007, p 16). Only a small percentage of the carcasses brought out by recreational hunters are sold.

Commercial harvesting of deer from conservation lands and the forest estate was discussed in Indicator 2.e. In 2012, four processing companies handled most of the feral deer that were commercially hunted.

A significant proportion of the annual cull of feral goats is for pest control rather than human consumption. Past surveys indicate there are several hundred thousand feral goats, and that they thrive in scrub-covered hill country on both conservation and private farm land (NZFSA, 2005). The browsing habits of feral goats pose a risk to indigenous plants and forest undergrowth (Department of Conservation, 2006). No recent studies have been undertaken on the number of feral goats culled annually. An assessment in the early 1990s estimated that 68 500 were culled over one season (57 000 by private hunters and the remainder by government hunters) (NZFSA, 2005). Two of the favoured hunting species, chamois and tahr,[33] have a combined harvest of nearly 2000 to 3000 per annum. They are mainly hunted for trophy heads rather than food consumption (Fraser, 2000; NZFSA, 2005).

Feral pigs "inhabit forest and scrublands, and are prevalent on rough hill-country farmland", covering around 34 percent to 37 percent of New Zealand (NZFSA, 2005, p 26). Most of the feral pigs are harvested from private farmland and plantation forests (Fraser, 2000; TBfree New Zealand, 2013). The annual cull was estimated by Nugget (1992 in NZFSA, 2005) to be roughly 100 000 per annum.

Data on game meat consumption is limited and mostly dated:

- Venison was reported to be consumed by 0.4 percent of respondents in the 1997 National Nutrition Survey, but data did not differentiate between game and farmed venison (NZFSA, 2005).
- The 1997 National Nutrition Survey contains no records representing consumption of goat, tahr or chamois (NZFSA, 2005).
- While the National Nutrition Survey found that 38 percent of the population consume pork during any 24-hour period there was no data on what proportion was derived from feral pigs (NZFSA, 2005).

Consumption of honey

New Zealand's honey production has averaged 12 524 tonnes a year over the 2008 to 2013 period (9267 tonnes per annum over 2001–07). Domestic consumption is estimated to be 5000 tonnes to 6000 tonnes per annum. The additional volume is exported, principally to the United Kingdom, Hong Kong/China, Australia and Singapore (Coriolis Limited, 2012; HortResearch, 2007; Plant and Food Research, 2013). The apiculture industry also produces beeswax, pollen and propolis (a resin marketed for its health benefits).

As discussed in Indicator 2e, the industry has seen steady production growth over the past decade, driven by strong international demand particularly for mānuka honey. Hive numbers have increased since 2005/06, and the number of registered beekeepers has grown over the 2009–2013 period (Ministry for Primary Industries, 2013). The industry has become a significant exporter, and the principal companies are some of New Zealand's most innovative, with research into the medicinal and pharmaceutical properties associated with honey.

The 1997 National Nutrition Survey found that the average consumption of honey was around 1.06 kilograms per person per year (NZFSA, 2005). As discussed previously, the statistics collected on honey production do not differentiate between the pollen and nectar sources, such as white clover or indigenous stands of mānuka. This would be a complicated exercise, as hives can be located in a variety of pasture and bush situations during a single season.

Possum fibre and associated products

The Australian brushtailed possum (*Trichosurus vulpecula*) was introduced to New Zealand in an effort to establish a commercial trapping industry. The first recorded shipment of possum pelts occurred in 1921. The market for pelts has been variable and driven by overseas trends in the fashion industry, the public view of fur products and the preference of international buyers. During periods of depressed pelt prices, the quantity of skins exported fell below 500 000, while in peak years (when returns were sufficient to provide a reasonable living for trappers) it exceeded 3 million. The negative image of fur in the 1980s and 1990s saw demand fall away.

The renewed interest in possum fur over the past 15 years has been driven by the development of a new fibre blend (incorporating possum and merino fibres) and local companies taking more control of processing

33 Tahr numbers are managed under Department of Conservation operational control plans.

and garment development. A description of the recent changes in the industry has been provided in Indicator 2.e. While the level of domestic processing has increased, the industry still depends on the export market to sell much of the yarn and final fashion garments. Blended possum and merino products are increasingly seen in New Zealand retail outlets. The blended fibre is used in products such as gloves, scarves and hats, which emphasise its heat-retention properties.

There has been limited use of possums as a game meat, because the animal can be a carrier of the tuberculosis vector and has been implicated in the spread of the disease to farm animals such as cattle and deer. Ongoing efforts by TBfree New Zealand and the Department of Conservation have been successful in reducing the infected population and enabling specific areas to be declared disease free. Possum meat is being used mainly in the production of pet food. The industry is in the initial stages of development, and the demand is coming more from the export market than local consumer interest.

Berry, herb and nut consumption

Berries, herbs and nuts were traditionally harvested by Māori as a component of their diet. Information is not collected on customary harvest levels (NZFSA, 2005).

Sphagnum moss usage

The sphagnum moss industry is export focused, with most of the harvest being supplied to overseas customers. (See Indicator 2.e.)

Whitebait harvesting

Whitebait is the generic term for the juvenile form of five fish species from the *Galaxiidae* family. The Māori population traditionally caught whitebait, and it has become one of New Zealand's aquatic delicacies. The harvesting of whitebait is controlled by the Department of Conservation and is limited to a short season in spring (about three months). Whitebait can be found in many of New Zealand's major rivers and streams, but its presence has generally declined in areas of extensive pasture land (that were drained in previous generations).

Intact forested catchments, with their higher water quality, continue to be a major source of whitebait. One of the best known areas for whitebait is South Westland (on the West Coast of the South Island), where most of the streams have their source within the conservation estate.

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Indicator 6.1.f Value and volume in roundwood equivalents of exports and imports of wood products

Forestry is the third-largest export earner for New Zealand, with merchandise trade exports for the June 2014 year valued at NZ$5.2 billion. In roundwood equivalent terms, nearly 82 percent of current harvested volume (25.2 million cubic metres) is exported either as logs or as processed product. Imports of wood and wood-based products are worth around $1.5 billion and, based on the product mix, contain the equivalent of 3.4 million cubic metres of roundwood.

Quality of information: H

Progress against indicator: ▲

Rationale

The indicator provides information about the value and volume of a country's exports and imports in wood products and their contribution to the domestic economy. International trade in wood products may be a significant factor in the management, commercial use and economic value of forests.

NEW ZEALAND'S REPORT

Roundwood removals (currently about 30 million cubic metres per year) far exceed New Zealand's domestic consumption of wood products (see Indicator 6.1.d). At present, in excess of 56 percent of the annual harvest (over 17 million cubic metres) is exported as logs and, in total, over 80 percent (nearly 82 percent for the June 2014 year) of the harvest volume is exported either as logs or processed product. The 44 percent of harvest that is not directly exported as logs is currently processed into a range of products for both domestic and export markets. While for the processed products the split between domestic consumption and export varies depending on the specific product, across all processed products around half of the total volume (in roundwood equivalent terms) is exported.

New Zealand has good statistical datasets covering the trade of forestry products. The annual values and volumes of these exports from 2008 to 2014 (June year) are provided in figures 6.2A and 6.2C.

New Zealand imports a little less than NZ$1.5 billion of wood products per year. The values and volumes of these imports are provided in figures 6.2B and 6.2D.

The four graphs show the main features of New Zealand's international trade in forest products over the past 14 years; falling export volumes (as roundwood equivalents) and export returns between 2001 and 2008, principally because of reduced volumes of log exports. This period of decline in log exports is then followed by a period of dramatic growth in both the volume and per unit value of log exports, about a compound 12 percent per annum increase in volume and a similar compounded increase in the per unit value, between 2008 and 2014. As a result of this, between 2008 and 2014, the sector's export earnings increased from $3.2 billion to $5.2 billion. Virtually all of the change in forestry's export fortunes over this six-year period is due to log exports. The annual volumes and the values of processed product exports (sawn timber, wood pulp, paper, panel and "other" products) have been virtually constant and unchanging throughout the 14-year period.

Imports for the first four years (2001 to 2004) saw an increase in the volume and value associated with growth in paper imports. That, in turn, reflects a static local paper industry that has increasingly been focused on producing a limited number of paper grades. From 2004 to 2013, imports in volume terms were relatively static at about 2.5 million cubic metres of roundwood equivalent per annum. During this period, there was a small upward trend in the total value of imports, reflecting growth in the unit value of "other" forest products imports.

The 2014 year has seen an increase in imports in volume and value terms. This increase is associated with imports of sawn timber and panels and is possibly associated with the ongoing rebuild of Christchurch following the earthquake damage in 2010/2011. Despite the recent growth in the volume (roundwood equivalents) of sawn timber imports, sawn timber is

not a big component of overall imports. Paper and panel products typically account for over 85 percent to 90 percent of the roundwood equivalent volume of imports, with paper and "other" products accounting for about 90 percent of the value. In roundwood terms, the volume of imports is only 14 percent to 20 percent of the volume of exports, while in value terms imports are 18 percent to 28 percent of the value of exports.

Source of information

Ministry for Primary Industries (2014) *Forestry: forestry production and trade statistics detail the production, trade, and other forestry activities in New Zealand*. **http://www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/forestry/.** Accessed 5 May 2015.

Figures 6.2.A, 6.2.B, 6.2.C and 6.2.D – Values and volumes of exports and imports of wood products

Figure 6.2.A: Value (actual NZ$000) of New Zealand exports of wood products

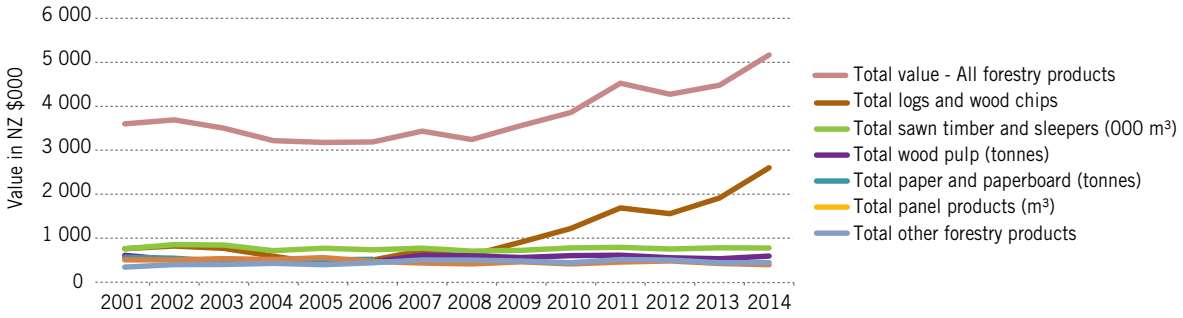


Figure 6.2.B: Value (actual NZ$000) of New Zealand imports of wood products

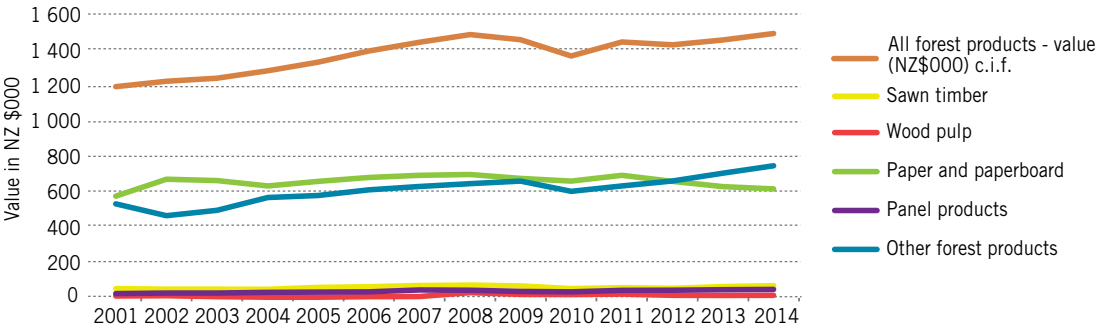


Figure 6.2.C: Volume (in roundwood equivalent 000 m³)) of New Zealand exports of wood products

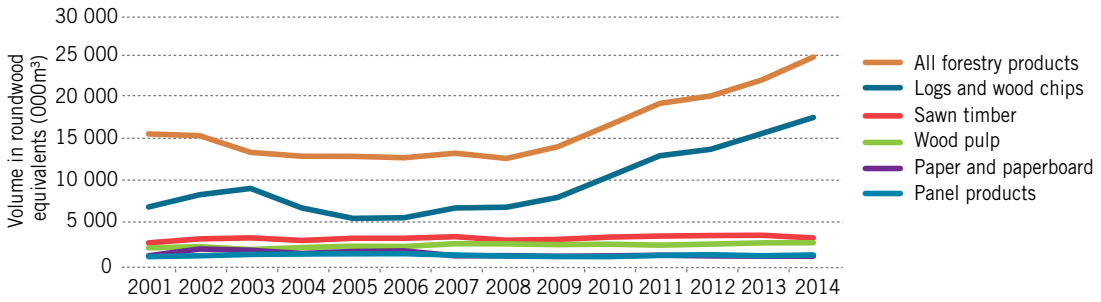
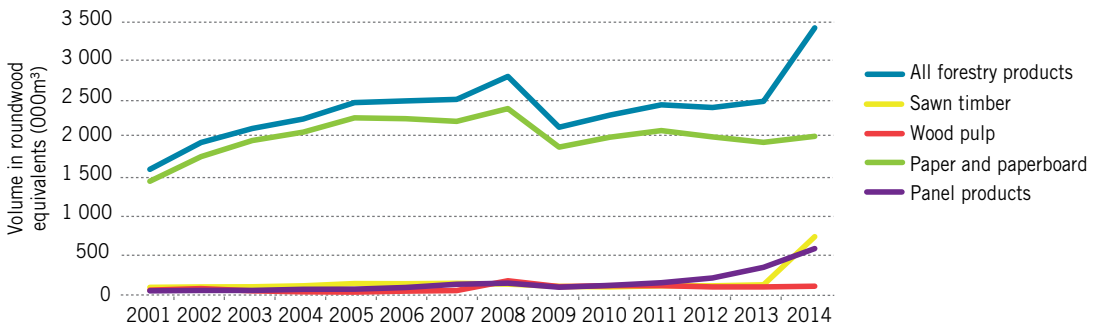


Figure 6.2.D: Volume (in roundwood equivalent 000 m³) of New Zealand imports of wood products



Indicator 6.1.g Value of exports and imports of non-wood forest products

New Zealand exports a limited range of non-wood forest products. The principal categories of exports are natural honey ($170 million), live bees ($4.4 million), sphagnum moss ($4.0 million) and fashion garments made from a blend of possum fibre and merino wool.

Non-wood forest products can also be found in a range of processed goods, including food flavourings and skin-care products (derived from plant extracts), and medical applications (sourced from natural products such as mānuka honey).

Imports of non-wood forest products are minimal. Only small quantities of natural resins, fur-skins and honey are imported each year.

Rationale

This indicator provides information about the value of a country's exports and imports of non-wood products and their contribution to the domestic economy. International trade in non-wood products may be a significant factor in the management, commercial use and economic value of forests.

NEW ZEALAND'S REPORT

In the 2013 calendar year, New Zealand's two-way merchandise trade (imports and exports) amounted to NZ$96.4 billion.[34] Non-wood forest products made up nearly 0.25 percent of this total.

Honey (and bee product) exports and imports

As discussed in indicators 2.e and 6.1.b, apiarists use both the forest estate and forest margins as sources of pollen and nectar.

The value of natural honey exports (in nominal terms) has increased from $27 million to $170.5 million between 2003 and 2013 (December year figures[35]), while imports over the same period have been less than $1.2 million per annum (with a low of $24 000). The export figures do not differentiate between pasture- and forest-based honeys, and in some cases they draw on both nectar sources.

The increase in honey exports has been driven by strong international demand (particularly for high-quality honeys), the growing reputation of mānuka honey and increasing demand from China. Chinese demand has grown, particularly since the introduction of the New Zealand–China Free Trade Agreement. The volume of honey exported in retail packs has increased significantly since 2007, while bulk honey exports have been declining over the past five years. The upturn in export demand has meant that "New Zealand suppliers have been able to invest more in the value-added component of their business" (Ministry for Primary Industries, 2013, p 4).

In addition to natural honey exports, apiarists supply overseas customers with live bees, beeswax and pollen. The export value of live bees and beeswax in the 2013 calendar year was $6.4 million. Imports of beeswax stood at just $80 000 and there were no imports of bees (Statistics New Zealand, 2014b).

These figures do not include situations where honey and honey extracts are used in the production of value-added products, such as cooking ingredients, pharmaceuticals or medical applications. One of New Zealand's monofloral honeys (based on mānuka) is gaining an international reputation as an antibacterial substance. Long-term research has been undertaken on the level of antibacterial activity in mānuka honey, and several commercial products have been developed and are now being exported.

34 This figure includes all merchandise trade in the December 2013 year. Merchandise trade covers exports and imports of goods that alter the nation's stock of material resources.

35 "Free on Board" export value – the value of goods at New Zealand ports before export (source: Statistics New Zealand, 2014b).

Possum fibre

The past 15 years have seen growing commercial interest in the fibre of the Australian brushtailed possum *(Trichosurus vulpecula)* for yarn manufacturing and the production of fashion garments. This interest is based on the thermal properties of the fibre and recent advances in yarn manufacturing, which have enabled it to be blended with merino to create a light-weight but high-quality yarn for clothing and textile production. The interest in possum fibre is helping to underpin the trapping industry and supports efforts to control possum numbers in New Zealand's forests.

The 2008 country report noted that the blending of possum fur and merino had become an established part of the New Zealand yarn industry and that the total value of the sector was estimated to be worth "in the order of $50 to $70 million per annum" (Warburton, 2008, p 8). More recent figures estimate the sector to have a turnover of around $100 million annually (Adams, 2010).

The growth in the sector has been supported by both domestic and overseas demand. Overseas visitors to New Zealand have been major purchasers of possum–merino products, such as jerseys and scarves. These purchases are recorded as domestic sales and are not included in the export figures. Blended yarns and textiles are being exported to a range of overseas customers and countries, with particular interest from China. Because these products are in a semi-processed or processed state, the trade database records the finished product rather than the raw material. This prevents an accurate estimate of possum-fibre exports.

Possum skins and pet food

The trade in possum skins saw progressive growth in the early to mid-2000s, with export activity increasing from $0.5 million dollars in the 2002 calendar year to $2.2 million in 2007 and $2.3 million in 2008. Export activity dropped during the global economic crisis with returns falling to only a few hundred thousand dollars in recent years. Imports of possum skins are negligible.

Previous reports have commented on the potential for developing export pet-food lines based on possum meat. Interest in this opportunity continues, and niche product lines have been developed. Separate figures are not available for the export of possum-derived pet food.

Sphagnum moss exports

The sphagnum moss industry has a strong focus on the export market, with a significant share of production going to customers in Japan and Southeast Asia (see indicators 2.e and 6.1.b). The major customers for sphagnum moss *(Sphagnum cristatum)* are orchid growers, as the moss can hold twenty times its own weight in water. Sphagnum moss also has medicinal uses, as it is a naturally sterile substance.

Export returns were between $13 million and $18 million during the 1990s and the early 2000s. Returns have declined over the past decade and have been between $3.9 million and $4.5 million since 2011 (Plant and Food Research, 2013). Part of this decline relates to the high value of the New Zealand dollar and competition from other Pacific Rim producers.

New Zealand imports only small quantities of mosses and lichens.

Foliage and live plant exports

New Zealand has a developing trade in the export of foliage, cut flowers and plants. Native plants have a small role in these exports. New Zealand has several species of *Pittosporum* that are valued for their

foliage by flower arrangers. Between $1.6 million and $1.8 million per annum of *Pittosporum* foliage was exported over the past four years (Plant and Food Research, 2013).

Other traded products

There is increasing interest in the use of native plant extracts in skin-care and medicinal products. Research is ongoing in this area, and several companies are working to develop overseas markets for these new product lines. Separate trade data is not available on these exports.

New Zealand has a small trade in natural gums and resins, a proportion of which are derived from forest and bush lands.

Sources of information

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Indicator 6.1.h Exports as a share of wood and wood products production, and imports as a share of wood and wood products consumption

As of 2014, over 80 percent of the annual volume of wood harvest in New Zealand is exported either as logs (over 56 percent of harvest) or in the form of locally processed wood products (sawn timber, pulp and paper, panel products) that is then exported. The wood material required to produce the wood products imported by New Zealand in the year to June 2014 was equivalent to around 11 percent of the domestically harvested volume.

Quality of information: M

Progress against indicator: ▲/▶

Rationale

This indicator provides information on the relative importance of international trade in wood and wood products to domestic production and consumption. Wood and wood product exports can be a significant source of revenue for domestic economies. Imports may supplement or substitute for production from domestic forest sources.

NEW ZEALAND'S REPORT

New Zealand has a well-managed sustainable plantation forest estate of some 2.1 million hectares (gross) – the net figure is 1.7 million hectares. The extent of the commercial forest resource, the typical growth rates (cubic metres per hectare per annum) and the size of the New Zealand population (estimated to be 4.5 million as of May 2014), mean domestic demand accounts for less than 20 percent of total current production (see Indicator 6.1.d).

The country is highly dependent on international trade, and most of New Zealand's wood harvest is destined for overseas markets. Wood and wood products are the third-largest export industry in New Zealand. Over the 2007–14 period, revenue from wood and wood product exports, which were worth $3.2 billion a year in 2007 and $5.2 billion a year in 2014, accounts for between 8 percent and 10 percent of the country's merchandise exports (depending on the year and the value of other exports).

For the 2014 (June) year, the total harvest was 30.6 million cubic metres of which 25.2 million cubic metres (in roundwood equivalents) were exported as logs, poles, lumber, panel products, joinery, furniture, pulp, paper and other miscellaneous forest products.

New Zealand imports wood and wood products to meet some of its domestic requirements. In 2007, the product imported represented nearly 2.5 million cubic metres (in roundwood equivalents). For 2008, imported product was equivalent to 2.8 million cubic metres (roundwood equivalents). With the global financial crisis, this dropped to 2.1 million cubic metres for 2009. Imports then stabilised at around 2.4 million cubic metres per annum for the next four years. However, 2014 saw an increase in the level (roundwood equivalents) from 2.4 million to 3.4 million, despite the fact that local harvest in 2014 was almost 50 percent higher than in 2007 and total domestic consumption 10 percent lower (with apparent consumption per capita 14 percent lower than in 2007). Furniture, paper and paperboard are the main imported items.

In 2007, New Zealand's estimated domestic consumption was 8.4 million cubic metres. Per capita consumption was just over 2 cubic metres in that year and 2.1 cubic metres in 2008 (see Table 6.7). With the global financial crisis, per capita consumption dropped to 70 percent of that previously applying, and, since 2010, per capita consumption has slowly inched up around 1.7 cubic metres to 1.8 cubic metres per annum in the 2011–13 period. For 2014, per capita consumption increased significantly to 1.975 cubic metres per capita per annum – which is almost back to the levels applying before the global financial crisis.

Imports currently account for 30 percent of the volume of total consumption. An example of the type

of information available for exports (and imports) is provided in Table 6.8.

Note that, since 2007, the values of paper and paperboard exports have been suppressed to comply with the confidentiality rules applied by Statistic New Zealand.

Sources of information

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Table 6.7: Estimated New Zealand production, imports, exports and apparent consumption of roundwood (2007–2014)

Year ended March	Mean NZ population (000)	Production (000 m^3)	Imports (000 m^3)	Exports roundwood equivalent (000 m^3)	Total apparent consumption (000 m^3)	Apparent consumption per 1000 capita (m^3)
2007	4 198	19 974	2 478	13 979	8 473	2 018
2008	4 241	20 481	2 755	14 213^E	9 023	2 127
2009	4 281	18 937	2 373	14 434^E	6 876	1 606
2010	4 332	22 042	2 153	17 460^E	6 735	1 555
2011	4 381	25 131	2 437	19 956^E	7 772	1 774
2012	4 415	26 070	2 469	20 859^E	7 832	1 774
2013	4 444	28 164	2 377	22 970^E	7 570	1 704
2014	4 489	30 258	3 384	24 776^E	8 866	1 975

Note: E = estimate.
Source: Ministry for Primary Industries, 2014a.

Table 6.8: Exports of forestry products from New Zealand, years ended 30 June 2007 to 30 June 2014

Forestry products in roundwood equivalents (000 m^3)	2007		2008		2009		2010		2011		2012		2013		2014	
	Quantity	Value (NZ$000)	Quantity	Value (NZ$000)	Quantity	Value (NZ$000)	Quantity	Value NZ$000	Quantity	Value NZ$000	Quantity	Value NZ$000	Quantity	Value NZ$000	Quantity	Value NZ$000
Logs and wood chips	7 026	729 057	7 109	626 882	8 294	922 294	10 778	1 230 527	13 309	1 697 226	14 083	1 566 540	15 982	1 921 393	17 912	2 609 544
Sawn timber	3 557	783 402	3 139	716 289	3 234	733 035	3 515	789 268	3 640	801 559	3 703	762 976	3 741	792 359	3 416	786 888
Wood pulp	2 715	621 785	2 698	608 726	2 607	569 587	2 662	613 758	2 540	622 219	2 674	565 040	2 818	544 051	2 838	603 682
Paper and paperboard	1 269		1 279		1 209		1258		1 332		1 260		1 219		1 221	
Panel products	1 350	443 973	1 230	424 136	1 179	472 808	1 163	425 655	1 314	468 273	1 395	493 771	1269	435 987	1 360	406 669
Other forestry products		516 525		513 312		490 872		453 251		524 310		512 942		452 522		455 252
TOTAL VALUE	**13 610**	**3 440 200**	**12 984**	**3 249 023**	**14 379**	**3 566 708**	**16 963**	**3 862 311**	**19 603**	**4 526 843**	**20 500**	**4 277 596**	**22 429**	**4 483 808**	**25 183**	**5 169 497**
Total NZ merchandise trade		**33 301 308**		**38 453 309**		**41 011 193**		**38 995 831**		**44 234 328**		**44 892 891**		**44 112 959**		**49 398 765**
Forestry products – exports as a percentage of total merchandise exports		10.33		8.45		8.70		9.99		10.23		9.53		10.16		10.46

Source: Ministry for Primary Industries, 2014b.

Indicator 6.1.i Recovery or recycling of forest products as a percent of total forest products consumption

With the exception of paper, New Zealand has made limited progress in the recycling of wood products. Significant volumes continue to go to landfills. The recycling (or safe disposal) of preservative-treated timber is an issue New Zealand must address.

Quality of information: L/M

Rationale

This indicator provides information on the extent to which forest products are recycled or recovered. Recycled and recovered products are an important source of wood fibre for many industries and may compete with, or substitute for, harvested wood. Such products can help meet the demand for forest products without increasing harvest levels.

NEW ZEALAND'S REPORT

Paper is the major forest product that is recycled in New Zealand and the only product for which recycling statistics are available. The annual tonnage of waste paper used in local manufacturing of paper and paperboard has been relatively static, but when coupled with the waste paper that has been recovered and exported, overall recovery of paper has been gradually increasing (see Table 6.9).

The total production of paper and paperboard for the year ended March 2014 was 749 314 tonnes. Based on the usage of waste paper in Table 6.10, the recycled component of production is around 30 percent. Total domestic consumption of paper is roughly 870 000 tonnes annually (Ministry for Primary Industries, 2014).

Little progress has been made in the recycling of waste timber and wood products (other than paper), with significant volumes going to landfills. In 2004, timber accounted for 14 percent of the then estimated 3.2 million tonnes of solid waste that went to landfills. This does not include waste disposal to cleanfill, construction and demolition waste landfill sites, or dedicated industrial waste landfills (Ministry for the Environment, 2007). More recent information indicates that timber still comprises at least 11 percent of the levied (nearly) 2.5 million tonnes nationally of solid wastes that are land filled annually.

Coping with numerous types of wood products, and finding reliable recycling suppliers, has presented problems to establishing recycling operations (InWood, 2005). Preservative-treated timber presents a new recycling (or disposal) issue for New Zealand, as the first significant volumes are beginning to reach the end of their (theoretical) life cycle.

Table 6.9: Waste paper exported or used for local paper and paperboard manufacturing (2006–2013)

Year ended December	Waste & scrap paper & paperboard exported (tonnes)	Waste paper used in local paper & paperboard manufacture (tonnes)
2006	242 299	222 062
2007	253 957	240 330
2008	261 309	260 064
2009	242 611	264 693
2010	240 300	245 456
2011	261 386	240 430
2012	255 419	241 308
2013	212 646	226 883

Source: Bartley, 2014.

A small and growing market has developed for the use of recycled indigenous timbers. These timbers are mainly recovered from the demolition of older buildings and houses constructed during the period when indigenous forests were the principal source of timber. The recycled timber is used in furniture manufacturing and (to a limited degree) in the construction of new houses.

Consumer demand for healthy living environments, along with regulatory demands for chemical free building products, is driving Scion's wood preservation team to develop bio-based alternatives to chemical wood preservatives.

In 2008, New Zealand passed into law the Waste Minimisation Act. This Act established a waste disposal levy that has been applied since July 2009 to waste disposed at disposal facilities. The levy has two purposes:

- to raise revenue for promoting and achieving waste minimisation;
- to increase the cost of waste disposal to recognise that disposal imposes costs on the environment, society and the economy.

The levy is currently set at $10 plus goods and services tax per tonne and generates a net income of nearly $25 million per annum. Half of this money goes to territorial authorities (allocated proportionally to their share of the population), to help them with minimising waste in their area. The remaining levy money (minus administration costs) is put into a fund to support waste minimisation activities around New Zealand.

Sources of information

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Marlborough Sounds, top of the South Island.

INDICATOR 6.2 INVESTMENT IN THE FOREST SECTOR

These indicators provide information on long-term and annual expenditures to enhance forest management, forest-based enterprises, and the knowledge and skills of people who are engaged in the forest sector. Maintaining and enhancing the long-term multiple socio-economic benefits derived from forests depends in part on investment in the forest sector, including both long-term capital investments and annual operating expenditures.

Indicator 6.2.a Value of capital investment and annual expenditure in forest management, wood and non-wood forest product industries, forest-based environmental services and recreation and tourism

Expenditure by the commercial forest industries is influenced by market conditions. These, both domestically and internationally, can only be described as being "challenging" in recent years. The dramatic growth in wood harvest in recent years (shown in Indicator 6.1.a) has been accompanied by a significant increase in investment in harvesting and transportation, but not in local processing (see Indicator 6.1.f and figures 6.2.a and 6.2b). Expenditure on forestry and logging in 2012 was 30 percent higher than in 2008. Expenditure in the pulp and paper subsector in 2012 was also a higher (7 percent) than in 2008, but investment spending in solid wood processing expenditure was at a high point in 2008, but in 2012, it was 10 percent lower. For non-wood forest products and the provision of environmental services, information on expenditure exists for some specific projects only.

After allowing for inflation, expenditure by the Government on all forestry-related activities is estimated to have been relatively static in real terms between 2005 and 2014.

Quality of information: L/M

Progress against indicator: ▶

Rationale

This indicator quantifies investment and expenditure in developing, maintaining and obtaining goods and services from forests. Maintaining and enhancing forests and their benefits often depends on regular investments in restoration, protection and management, as well as in operations, forest industries and forest-based environmental services. When the capacity to protect, manage and use forests is eroded through lack of funding, the benefits that forests provide may decline or be lost.

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Systematic information and estimates are available on the capital stock annual expenditure (and revenue) for the commercial (plantation) forest sector and for expenditure by the Crown and private sector on several specific forestry-related issues.

Expenditure on non-wood forest product industries, forest-based environmental services, recreation and tourism information collection is less systematic than is the case with the pure commercial material. Information that is collected and tagged as being forestry related frequently relates to specific (and possibly time limited) projects. There is significant and ongoing Crown expenditure, for example, in pest control and/or biosecurity, most notably by the Department of Conservation (DOC) but also by MPI and Ministry of Business, Innovation and Employment (MBIE), which affects the long-term environmental services of both forest and other lands where the forest-based component of that expenditure is not clearly separated and identified.

Commercial forest management and wood-based products

Both capital investment and annual expenditure by commercial forestry enterprises are influenced by market conditions. Estimates of net capital stock and total expenditure to 2012 for the major industry categories are provided in tables 6.10 and 6.11.

The detailed breakdown given in Table 6.10 is currently only available to 2012, while the expenditure data (Table 6.11) is only to 2013. The broader gross domestic product (GDP) measure (output less intermediate consumption) is available for forestry and logging and for the combined wood and paper products manufacturing for 2012 and 2013. These numbers indicate a continuation of the trends evident in Table 6.10 – growing forestry and logging output and a relatively stable net contribution from local wood-based manufacturing.

These results are consistent with an increasing capital stock in the forestry and logging subgroup, relatively stable capital stocks in wood product manufacturing,

Table 6.10: Net capital stock and gross domestic product measures ($ million) by ANZSIC06[1] industry groups (March year)

Year	Net capital stock[2]			Output			Intermediate consumption		
	Forestry & logging	Wood product manuf	Pulp, paper & converted paper prod manuf	Forestry & logging	Wood product manuf	Pulp, paper & converted paper prod manuf	Forestry & logging	Wood product manuf	Pulp, paper & converted paper prod manuf
2008	1 249	2 269	1 992	2 413	4 911	2 983	1 513	3 455	2 125
2009	1 359	2 310	1 883	2 743	4 206	3 036	1 847	3 110	2 368
2010	1 477	2 296	1 730	3 143	4 082	3 130	2 016	2 854	2 310
2011	1 574	2 188	1 590	3 607	4 482	3 256	2 271	3 106	2 422
2012	1 712	2 101	1 594	3 587	4 290	3 180	2 440	3 025	2 430

Notes: 1. ANZSIC = Australian and New Zealand Standard Industrial Classification.
2. Chain-volume series expressed in 2009/10 prices.
Source: Statistics New Zealand, 2014a (tables 1 & 3).

Table 6.11: Total expenditure ($ million) by relevant ANZSIC[1] group

ANZSIC group	2008	2010	2011[2]	2012[2]	2013[2]
Forestry and logging	2 522	2 778	2 967	3 284	3 359
Wood product manufacturing	4 852	4 187	4 544	4 414	4 446
Pulp, paper and converted paper product manufacturing	3 013	3 205	3 263	3 234	3 424

Notes: 1. ANZSIC = Australian and New Zealand Standard Industrial Classification.
2. These figures are provisional.
Source: Statistics New Zealand, 2014b.

and a possible slow decline in the capital stocks associated with paper manufacturing (although there has been a recent $60 million investment in upgrading tissue manufacturing plus investment in refurbishing one pulp mill). This result is in line with the increase in harvest and the growth of the export log trade rather than growth in manufactured timber exports, as evident in Indicator 6.1.a.

For wood product, and paper and paper product manufacturing, all investment and expenditure is from private enterprises. Central and local government own about 5 percent of the plantation forest resource, so a small component of the expenditure under forestry and logging is from public sources.

For forestry and logging, the growth in expenditure over the period is accounted for by the levels of harvest, which grew from 20.4 million cubic metres in 2008 to 30.3 million cubic metres in 2014 (years ending 31 March).

Crown forestry

For 2005, forestry-related operational expenditure and transfer payments by New Zealand's two principal government agencies with forestry responsibilities, DOC and the then Ministry of Agriculture and Forestry (now the Ministry for Primary Industries), were estimated as being $221 million. The forestry-related component of these two agencies' expenditure has grown to a projected $270 million for the coming (2014/15) year (The Treasury, 2014 a,b).

Other expenditure is carried out by both agencies (but particularly DOC) and some other agencies that is intended to maintain and enhance environmental and recreational services in general, for example, pest control. This expenditure can be undertaken on forestry lands but is not specifically tagged as forest expenditure.

Under the Conservation Act 1987, all Crown land in New Zealand designated for conservation and protection is managed by DOC. The land area involved (about 8.8 million hectares – Earl, 2014) represents over 30 percent of the country's land mass, the bulk of which is classified as indigenous forest land. DOC has an annual appropriation in excess of $440 million to manage all its lands, and a portion of this expenditure should be counted as part of state forestry spending (The Treasury, 2014a).

Non-wood forest products

The non-wood forest products industry is not well developed in New Zealand, and little information is available on investment or total income potential. The main recognised products, in commercial terms, are game meat (feral deer and pigs), pelts, sphagnum moss and honey. In addition, small quantities of berries and fungi are harvested annually, along with plant extracts for medicinal remedies and healthcare products (see indicators 2.e and 6.1.b).

This summary does not do justice to the wide range of species and products harvested both commercially and non-commercially. Nor does it indicate the economic impact many non-wood products could potentially make. For example, recent research that attempted to scope the ginseng industry potential in the central North Island concluded not only that the product adds a layer of possibilities for standard commercial forestry, but over half of the 450 000 hectares of plantation forests in the central North Island have suitable environmental and geophysical conditions to grow wild simulated ginseng. That potentially offers a large and significant benefit for New Zealand's economy, because the analysis also indicated that adding ginseng could double profitability compared with forestry alone, returning an additional 154 percent to 188 percent value per hectare of plantation forest (Scion, 2013).

Another example of ongoing research with positive environmental effects and potentially significant economic impacts is the "High-performance Mānuka Plantation" programme. Mānuka honey was worth $75 million to the New Zealand economy in 2010. This research programme, which is jointly funded by industry ($1.49 million) and the Crown ($1.4 million), aims to convert lower quality land to mānuka plantations, principally for honey production. Conversion is likely to have positive environmental effects in terms of land stabilisation and reduced erosion. It also has the potential to increase honey income from the 2010 figure of $75 million per annum to around $1200 million by 2027. To date, Crown expenditure on this project is $379 000, and private sector funding has been comparable (Ministry for Primary Industries, 2015).

Environmental services

All forests provide environmental services of differing types and to differing degrees. For New Zealand, the primary environmental services include maintenance of biodiversity, soil conservation, maintenance of water quality, carbon sequestration and storage, and landscape values. Environmental, recreational and tourism services are the main output of indigenous forests under DOC management.

Environmental services, at least as far as the commercial plantation estate is concerned, are only components of, or secondary benefits from, broader forest management objectives. Given that over half of all the New Zealand plantation forest area is Forest Stewardship Council-certified and that certification requires management incorporating environmental values, there is specifically recognised environmental spending associated with over half of all the plantation estate. Unfortunately, good, systematic information on total financial expenditure for any specific environmental service clearly tagged to being purely "forestry" related and on a national basis, is not readily available. Expenditure on a few specific initiatives is addressed below.

The Erosion Control Funding Programme (ECFP) (previously the East Coast Forestry Project) is a government-tendered grant scheme that has been in operation since 1992 (first plantings occurred in 1993). Its aim is to help mitigate severe soil erosion in the East Coast region of the North Island through forest establishment, using poplar and willow treatments and indigenous (native) regeneration. Since 1992, landowners have used the fund to treat soil erosion on 42 000 hectares.

Nearly $26 million remains available in the ECFP until 2020, after which no new applications will be accepted. Some funding will still be available for final maintenance payments available until 2028 when the ECFP is due to expire. The remaining money is sufficient to treat around another 12 000 hectares to 25 000 hectares.

The New Zealand Emissions Trading Scheme (ETS) allows owners of post-1989 forest on eligible land to freely choose to participate in the ETS, take responsibility for managing carbon stock changes on that land and earn carbon credits where the carbon stock increases (see Indicator 6.1.c).

Recreation and tourism

The management of recreational opportunities by DOC in 2013/14 cost $137.95 million (Department of Conservation, 2013), and the 2014/15 expenditure is budgeted at $144.9 million (The Treasury, 2014a). In 2001/02, the provision of recreational opportunities and management of visitor and public information services by DOC accounted for $60.6 million.

Plantation forests are commonly available for restricted recreational activities, with a few forests having high levels of use.

Despite the lack of comprehensive data on expenditure on recreation in plantation forests, several

papers (for example, Yao et al, 2013; Clough, 2013; and Patterson and Cole, 2013) in a recent national assessment of ecosystem services in New Zealand indicate significant recreational benefits arising from a small sub-set of plantation forests. DOC's annual report for the year ended June 2013 indicates current expenditure is maintaining the recreational and tourism value of the estate it administers (Department of Conservation, 2013).

The recent book *Ecosystem Services in New Zealand* (Dymond, 2013) indicates not only significant recreational and tourism values for the indigenous estate but that those for the plantation estate are also significant. For example, Yao et al, 2013, report two studies of recreation benefits in Whakarewarewa Forest (an exotic plantation forest) worth $9 million and $28 million per annum respectively. (These recreational values exceed the value of the annual wood production from this forest.)

The importance of better measures of the non-market values is well illustrated in the Dymond (2013) publication, which indicates that the worth of values not measured and accounted for by the System of National Accounts significantly exceeds the worth of the commercial values captured by this system.

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Further reading

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Ministry for Primary Industries. http://www.mpi.govt.nz

Indicator 6.2.b Annual investment and expenditure in forest-related research, extension and development, and education

In New Zealand, there are numerous research consortiums, research providers and industry arrangements, although most government agencies are organised by functional groupings rather than around a specific sector or industry. This means it is a challenge putting a firm and precise value on the forest component of any government expenditure.

Since the last report, in 2008, the data indicate that there has been a slight decrease (in real terms) in clearly identified purely forestry-related research expenditure. However, during this period, overall research expenditure has increased significantly as has expenditure on a growing number of collaborative, multi-disciplinary research projects that either have some forestry component and/or involvement of researchers from an institution with a forestry orientation (see Scion, 2014). Expenditure has also increased on training and obtaining skills that will likely be required if the sector is to fulfil its perceived potential.

Rationale

This indicator provides information on annual investment and expenditure in forest-related research, extension and development, and education. Research underpins scientific understanding, including the ability to practise improved forest management and develop and apply new technologies. Education, including extension activities, increases public awareness of the multiple benefits provided by forests.

NEW ZEALAND'S REPORT

Research and development funding

In New Zealand, the principal source of research and development (R&D) funding is central government. Over the three years from 2005/06 to 2007/08, the average vote to Research, Science and Technology was $642 million. In the three years from 2011/12 to 2013/14, expenditure averaged $779.1 million, while the 2014 Budget figure for 2014/15 year is $966.6 million.

MBIE is the agency that manages and co-ordinates the allocation of the bulk of research funding and monitors the effectiveness of the public sector investment. Using information from the *Draft National Statement of Science Investment 2014–2024* (Ministry of Business, Innovation and Employment, 2014), Table 6.12 gives an approximate split of current government research spending by "driver" or proposer of the research. It also provides a summary of the agencies involved in supplying the Government funding and associated with oversight of the expenditure of the Government research and development money in a particular category.

Table 6.12: Estimated government forestry research funding

Use of research funding directed by:	Percentage of overall funding spent in this area	Funding administered by:
Researcher	20	Tertiary Education Commission, Royal Society of New Zealand
Sector research organisation	50	Ministry of Business, Innovation and Employment, Health Research Council
Industry	25	Ministry of Business, Innovation and Employment, Ministry for Primary Industries, Callaghan Innovation
Funding for international, infrastructure, science in society and so on	5	Ministry of Business, Innovation and Employment

Source: Derived from MBIE, 2014.

Table 6.13 gives an estimate of the proportion of voted government science funding that is invested in forestry.

The projected government science investment profile over the next 10 years (to 2023/24) peaks at around $1456 million in 2015/16, followed by a reduction to a relatively stable $1350 million to $1374 million per annum over the following seven years (The Treasury, 2014). Virtually all of the reduction in forecast government science funding is due to projected changes to two funding areas. The first is a reduction in MBIE funding of sector-specific research (a forecast reduction in funding of around $30 million per annum from a high of $218 million per annum to $189 million per annum in 2023/24). The second is a $60 million per annum reduction in government funding of Callaghan Innovation. This latter reduction should, in terms of government-funded forest research, have a relatively limited impact. The former (reduced MBIE sector research funding) could potentially impact on the level of forestry research, as indicated in Table 6.13. Even allowing for this, forestry is still likely to represent between 4 percent and 5 percent of total government research.

Historically, government science investment has been heavily focused on the primary sector and, in 2013, nearly 20 percent of government R&D was allocated to agriculture or forestry. Over 10 percent of the country's research effort was directed towards environmental research, some of which supports the primary sectors by exploring matters such as sustainable land use. Additionally, at least 2 percent of the 24 percent attributed to university funding is also attributable to research related to primary industries.

Overall, it is likely that, in some form, well over a quarter of government R&D expenditure supports primary industries, including forestry (The Treasury 2014). Finally, while not all research in areas such as transport, industrial production, energy and general advancement of knowledge (in total over 30 percent of all government R&D) is necessarily relevant to forestry, the potential is clearly there for forestry to benefit in some cases.

The forestry sector's own contribution to R&D funding is difficult to calculate, due to the numerous research consortiums and research provider and industry arrangements. In many instances, there are also significant in-kind contributions to research programmes.

Forest growers levy

This levy illustrates the difficulties in isolating and defining forest-related research, extension and development expenditures. The levy was grower driven and resulted from a vote for approval by growers.

The forest growers' levy came into force on 1 January 2014 and is paid on logs harvested from New Zealand plantation forests. Forest owners are primarily responsible for payment, which is made to the Forest Growers Levy Trust (FGLT). The FGLT sets the levy rate and is responsible for overseeing spending of the money raised. For the 2014 calendar year, the levy rate is set at 27 cents per tonne of harvested wood material (excluding non-commercial domestic firewood).

The FGLT is able to strike different levy rates for future years, but after five years (and again after every subsequent five-year period) all growers must vote on

Table 6.13: Estimated government forestry research funding ($000)

	2009/10	2010/11	2011/12	2012/13	2013/14
Government Appropriation Science and Innovation	721 618	770 085	756 694	790 974	789 588
Estimated primary sector research funding	180 404	192 521	189 200	197 500	197 397
Estimated forestry research funding	28 865	33 113	34 051	35 550	35 531
Forestry percentage of estimated primary sector research	16	17.2	18	18	18
Forestry as percentage of Vote Science and Innovation	4	4.3	4.5	4.5	4.5

Source: MBIE, 2014.

whether or not they wish to continue with a levy. At this, and all subsequent five yearly votes, at least 80 percent of those voting, by number and by harvest volume, need to vote in favour for the levy to continue. (The system is designed to avoid the risk of a few large owners being able to dictate outcomes that are not acceptable to a much larger number of smaller growers.)

The general purposes for which the FGLT may spend the levy are:

- research and development;
- forest biosecurity;
- the National Forest Health Surveillance Scheme;
- health, safety and education;
- supporting implementation of the Wood Council of New Zealand's Strategic Action Plan;
- facilitation of industry collaboration on issues of general concern, for example, health and safety;
- generic industry and product promotion;
- information dissemination;
- representing the interests of forest owners and the industry;
- administration costs.

The levy is not to be spent on any commercial or trading activities. With the current harvest level, it should raise around $8.2 million to be spent on the identified functional areas. Most of these are clearly the type of forest-related research, extension, development and education covered by Indicator 6.2.a. Some expenditure, for example, possibly that on supporting the Wood Council of New Zealand's Strategic Action Plan (Woodco, 2012), facilitating industry collaboration, generic promotion, representing the interests of owners and industry and administration, should possibly be excluded as not strictly related to Indicator 6.2.a.

Primary Growth Partnership

The Primary Growth Partnership (PGP) is a government–industry initiative investing in significant and/or transformational programmes of primary sector research and innovation. The aim is to boost the productivity and profitability of the sectors delivering a significant increase in longer-term economic growth and sustainability.

PGP programmes are business-led and market-driven innovation proposals working along the primary sector's value chains. PGP is managed by the Ministry for Primary Industries and is open to any entity, including firms, industry bodies, private research organisations, individuals, Crown research institutes and local government businesses. PGP investments cover education and skills development, R&D, product development, commercialisation, commercial development and technology transfer. While most PGP proposals contain a significant science component, the PGP is not mainly a science fund.

The ClimbMAX harvester is a steep slope harvesting machine, felling and bunching trees on slopes up to 45 degrees.

Table 6.14: Revenue sources for Competenz (2012–2013)

Revenue	2012 $000	Percentage	2013 $000	Percentage
Government revenue	18 940	61.7	12 967	66.5
Other income	11 723	38.3	6 638	34.5
TOTAL	**30 663**	**100**	**19 495**	**100**

Source: Competenz, 2013.

One of the goals in creating the PGP was to encourage more private investment in primary sector research and development. Core to the idea of the partnership approach is matched funding by industry, which must contribute at least 50 percent of any programme's funding.

As of April 2014, total government funding paid to programmes already under way (including three forestry programmes) was $99.9 million. In 2014, the total committed investment in PGP proposals over the duration of the established programmes is $708 million. This figure includes $333 million of Crown funding. Three forestry programmes (described below) represent 3.2 percent of the total investment. A mānuka honey project, represents another 2 percent of the total, as mānuka is a valuable non-wood forest product. Again, this highlights the challenge in identifying value add forestry-related research investment.

The Steepland Harvesting programme aims to reduce steepland harvesting costs by 25 percent; grow harvest machinery manufacture in New Zealand to future-proof the sector; and make harvesting jobs safer. The centrepiece of this programme is the development of a steep-slope, feller–buncher machine which can operate safely and efficiently on steep slopes without endangering workers. Government and industry have committed $3 million each over 6 years from 2010.

The Stakeholders in Methyl Bromide Reduction (STIMBR) programme researched sustainable and effective alternative phytosanitary and biosecurity treatments for the fumigant methyl bromide. Methyl bromide is an ozone depleting substance, though its continued use for quarantine and phytosanitary treatments is allowed. It is used for New Zealand logs and other primary sector exported products. The STIMBR programme ended on 30 June 2014. The total programme funding was $2.65 million, with $1.19 million from government.

The Stump to Pump PGP programme investigated how to generate more value from forestry waste by converting it to liquid biofuels. This feasibility study into the commercial viability of a biofuels business using radiata pine residues was a comprehensive and rigorous assessment of all key aspects from feedstock characteristics and availability, to design and technical viability of a test plant, to fuel distribution and logistics. The programme provided the partners with a significant amount of technical understanding around the potential to produce biofuels from forestry waste. The total programme funding was $3.62 million, with $1.81 million from government.

Sustainable Farming Fund

The Sustainable Farming Fund (SFF) invests in farmer, grower and forester led and aquaculture projects that deliver economic, environmental and social benefits to New Zealand's primary industries. Funding was up to $8 million a year. Examples of forestry projects include establishing the best silvicultural practices for adding value to new durable eucalypt plantations; an investigation of the potential of redwoods and eucalypts by investigating timber quality, durability and growth strains; and initiatives to support the national wilding conifer strategy.

Education and training

Over the 2011–2014 period significant structural change has occurred in the industry training sector. At the start of 2011, 38 sector or industry-based industry training organisations (ITOs) were servicing ongoing industry training needs. Forestry establishment, harvesting, solid-wood processing, wood panels, forest health, and pulp and paper production were under the Forest Industries Training and Education Council (FITEC). By January 2014, mergers (including that of FITEC with Competenz[36] in 2012) among these ITOs had reduced their number to 12 larger organisations that are multi-sector or multi-trade focused.

36 Competenz is a multi-sector industry training organisation.

In 2013, there were 5253 forestry and wood manufacturing trainees registered with Competenz.

At university level, forestry education throughout the period 2011–2014 period continued to be based at the University of Canterbury's School of Forestry. Graduate numbers from the university (forestry and forest engineering degrees) over the past few years ranged from 14 to 20 per annum (average 18) (New Zealand Forest Owners Association, 2009–2013).

Achieving the goals outlined in the Wood Council of New Zealand's 2012 Strategic Action Plan will require a larger forestry workforce, increased education and training, with the focus being on engineering, building and business rather than forestry (Grimmond et al, 2014).

In 2013, total funding for Competenz was $19.5 million (see Table 6.14). Government funding was around two-thirds of this with other sources (industry in the main) providing the last third. Of the 21 292 learners, a quarter were enrolled in either a forestry or wood manufacturing course. The split between forestry and wood manufacturing was around one-quarter wood manufacturing and three-quarters forestry.

Funding for the University of Canterbury degree courses in forestry science and forest engineering totalled $3.5 million in 2014 ($2.2 million in 2007) (Manley, 2014).

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INDICATOR 6.3 EMPLOYMENT AND COMMUNITY NEEDS

Forest-based and forest-related employment is a useful measure of the social and economic importance of forests at the national and local level. Wage and income rates and injury rates are indicators of employment quality. Communities whose economies are concentrated in forest industries, or who rely on forests for subsistence purposes, may be vulnerable to the short or long-term effects of economic or policy changes in the forest sector. These indicators provide information on levels and quality of forest employment, community resilience to change, use of forests for subsistence purposes, and the distribution of revenues from forests.

Indicator 6.3.a Employment in the forest sector

Forest management and timber processing are seen as one of the drivers of regional economic activity in New Zealand. The sector is a significant employer in its own right and underpins economic activity in several regional towns and centres. The sector also has significant downstream employment in further processing and support services, such as transportation, furniture manufacturing and timber wholesaling. The wide geographical spread of the forest estate means employment opportunities exist in nearly all districts. These opportunities include not only operational activities in the forest or mill but also positions in marketing, accounting and management. Employment activity has declined over the past decade, due to a combination of increasing productivity, restructuring within the sector and changes in market and foreign exchange conditions. Longer term, the potential exists for additional employment opportunities as the plantings of the 1990s mature and new uses for timber fibre are commercialised.

Rationale

This indicator provides information on the level of direct and indirect employment in the forest sector. Employment is a widely understood measure of economic, social and community wellbeing.

NEW ZEALAND'S REPORT

The forestry sector has been a significant contributor to employment and economic activity in New Zealand since the mid-19th century. The modern picture of the sector is of a diversified industry, with employment opportunities ranging from logging and sawmilling through to laminated veneer, pulp and paper manufacturing, energy production and research on bio-material applications.

In 2002 nine regions had over a thousand workers directly employed in forestry management, harvesting or first-stage processing (Table 6.15). While the level of forestry employment has declined over the past decade, the sector remains a significant employer across the country.

The central North Island has the largest number of workers employed in forestry and first-stage timber processing. The region had 37.6 percent of direct forestry employment in 2013 (as shown in Table 6.15). This concentration of employment reflects the distribution of mature forests and processing capacity. The central North Island was the focus of the initial round of plantation plantings in the 1920s and 1930s.

The New Zealand Forest Service sought to broaden the distribution of plantings in the decades following the Second World War, with the establishment of new plantations in regions such as Northland, Nelson/ Marlborough and Otago/ Southland. Private investors also took on a larger role in forestry development during this period. A noticeable development was the growth in small, farm forestry plantings. These plantings have created a geographically dispersed estate. The maturing of these plantings from the

1990s has enabled regional harvest rates to be sustainably increased over the past 20 years.

The increase in regional harvest activity led to a period of new investment in processing facilities during the 1990s and the early part of this century. This generated employment growth across the country. In the case of Otago/Southland, the combined region experienced 3.6 percent annual growth in full-time employment between 1994 and 2003, which was "over three times the regional annual average growth rate in FTE [full-time equivalent] employment of 1.1% p. a. [per annum]" (Business and Economic Research Limited, 2005). The growth in regional harvest volumes generated additional employment across the country.

In looking at forestry employment activity, it is important to examine not only direct employment but also indirect and induced workforce activity. In the Otago/Southland region:

> ...the indirect and induced impacts of the sector generate[d] a further 3,047 FTEs [full-time equivalents] and $214 million in real GDP [gross domestic product] elsewhere in the region. In broad terms every one FTE employed in the sector generates a further 1.3 FTEs elsewhere in the region (Business and Economic Research Limited, 2005, p 17).

A similar study in the Marlborough district found that:

> ...including indirect and induced effects, the forest industry generated $170 million in regional GDP [gross domestic product] and employed 1,090 FTEs [full-time equivalents] in the year ending March 2007. (Business and Economic Research Limited, 2008, p 24)

Recent trends in employment activity

Over the past 10 years, the forestry sector has seen a decline in employment activity (see Tables 6.16 and 6.17). This has been due to improvements in productivity, along with market and exchange rate conditions. The sawmilling and processing sectors have experienced tight margins over several years (for both domestic and export markets). This has led to a number of mill closures and initiatives to improve mill throughput and productivity. The rise in the log harvest over the past four years has stabilised the employment levels in forestry and logging.

Between 2002 and 2013, the workforce engaged in forestry and first-stage processing has declined by around 30 percent (as shown in Table 6.15 and Table 6.16). All 10 wood supply regions have seen a reduction in employment activity. The central North Island has seen the largest fall, with the "employee count" declining by 3977 or 38 percent.

The downturn in new planting at the beginning of the century, and tight economic conditions, had a significant impact on the number of workers employed in nursery operations, site preparation, planting and silviculture (that is, support services). This segment

Table 6.15: Regional distribution of employment in forestry and first-stage processing (February totals)

Region	Employees 2002	Percentage	Employees 2007	Percentage	Employees 2013	Percentage
Northland	2 300	9.3	1 962	9.6	1 679	9.7
Auckland	1 847	7.4	1 500	7.3	1 426	8.2
Central North Island	10 500	42.3	7 891	38.6	6 523	37.6
East Coast	1 010	4.1	810	4.0	800	4.6
Hawke's Bay	1 112	4.5	1 083	5.3	1 046	6.0
Southern North Island	2 100	8.5	1 870	9.1	1 410	8.1
Nelson/Marlborough	1 913	7.7	1 857	9.1	1 616	9.3
West Coast	620	2.5	450	2.2	316	1.8
Canterbury	1 457	5.9	1 418	6.9	1 196	6.9
Otago/Southland	1 993	8.0	1 627	7.9	1 351	7.8
NATIONAL TOTAL	**24 852**		**20 389**		**17 363**	

Notes: 1. The figures are based upon "employee count" (that is, a head count of all salary and wage earners for the February month). The "full-time equivalent" count was discontinued in 2003 and replaced with the "employee count" in 2004.
2. Employment figures are rounded and discrepancies may occur in compounded figures.
3. The 2013 data incorporate the changes to the Auckland region in 2010.
4. Percentages may not add to 100 due to rounding.

Source: Ministry for Primary Industries, 2013.

Table 6.16: Employment in forestry and first-stage processing (2002–2013)

ANZSIC code 2006 (1996)	Description of activity	2002	2007	2012	2013	Percentage change (2002-13)
A030100 (A030100)	Forestry	980	550	740	730	–25.5
A030200 (A030200)	Logging	4 590	3 610	3 960	3 970	–13.5
A051000 (A030300)	Forestry support services (services to forestry)	3 860	2 310	2 310	2 210	–42.8
C141100 (C231100)	Log sawmilling	7 430	6 750	5 130	5 020	–33.2
C141200 (C231200)	Wood chipping	30	9	30	25	–16.7
C141300 (C231300)	Timber re-sawing and dressing	1 760	2 200	1 740	1 800	2.3
C149300 (C232100)	Veneer and plywood manufacturing (plywood and veneer manufacturing)	1 800	1 730	1 230	1 220	–32.2
C149400 (C232200)	Reconstituted wood product manufacturing (fabricated wood manufacture)	1 340	1 140	800	760	–43.3
C151000 (C233100)	Pulp, paper and paperboard manufacturing	3 040	2 090	1 770	1 680	–44.7
Forestry and first-stage processing		**24 852**	**20 389**	**17 710**	**17 415**	**–29.9**
Total labour force as at March quarter (3)		**1 980 200**	**2 238 000**	**2 402 100**	**2 395 600**	**21.0**

Table 6.17: Employment in industries associated with forestry (2002–2013)

ANZSIC code 2006 (1996)	Description of activity	2002	2007	2012	2013	Percentage change (2002-13)
C149200 (C232300)	Wooden structural fitting and component manufacturing (wooden structural component manufacturing)	4 510	6 140	4 650	4 730	4.9
C149900 (C232900)	Other wood product manufacturing (wood product manufacturing (n.e.c))	2 130	2 130	1 860	1 760	–17.4
C251100 (C292100)	Wooden furniture and upholstered seat manufacturing	6 370	5 630	3 640	3 440	–46.0
C152100 (C233200 and C233300)	Corrugated paperboard and paper container manufacturing (solid paperboard container manufacturing and corrugated paperboard container manufacturing)	1990	1 880	1 480	1 410	–29.1
C152200 (C233400)	Paper bag manufacturing (paper bag and sack manufacturing)	230	190	80	70	–69.6

Notes to Tables 6.16 and 6.17

1. The figures are based on "employee count" (that is, a head count of all salary and wage earners for the February month).
2. Employment figures are rounded and discrepancies may occur in compounded figures.
3. The total labour force figures are derived from the Household labour Force Survey, Statistics New Zealand.
4. ANZSIC = Australian and New Zealand standard industrial classification.
5. n.e.c = not elsewhere classified.

Source: Ministry for Primary Industries, 2013.

of the industry declined by 1550 workers between 2002 and 2007. The workforce has stabilised in more recent years.

The numbers employed in logging are determined by the annual harvest and improvements in productivity (particularly on steeper slopes). Harvest volumes in 2007 were nearly 5 percent lower than in 2002, due to exchange rate and market conditions. Employment numbers experienced a sharp decrease (nearly 1000), as contractors sought to reduce costs by adopting new technology and systems to increase employee productivity. Employment levels have increased by nearly 10 percent from the 2007 low, due to the rise in harvest volumes over the past four years.

Employment in log preparation and sawmilling has fallen by 33 percent since 2002. The decrease has been felt particularly since 2008, with domestic and international markets affected by the global economic downturn. Tight margins, a fall-off in demand from major overseas markets and more recently higher log input prices have seen restructuring and further efforts to improve productivity in the sector. The sector has seen several mill closures over recent years.

The re-sawing and dressing segment of the industry (for example, floorboards, mouldings and kiln dried timber) experienced a 25 percent increase in employment between 2002 and 2007 and absorbed a proportion of the employment that was lost from sawmilling. This employment trend has been reversed over the past five years (due to the factors listed previously) and employment numbers are on par with 2002.

Ongoing rationalisation in the pulp, paper and paperboard industry has seen employment numbers decline by 43 percent since 2002.

A sample of the downstream manufacturing activities associated with the forestry sector is shown in Table 6.17. One of the growth areas for employment in the early 2000s was the structural component industry, which includes the manufacturing of wooden structural fittings, wooden components for prefabricated wooden buildings, wooden door frames, roof trusses and the like. Between 2002 and 2007, the industry experienced positive growth of 36 percent (1630 workers). In line with the wider sector, the structural component industry experienced difficult market conditions post 2008 and this led to a period of restructuring and job losses.

The furniture industry has traditionally been a significant employer of skilled cabinet makers and

wood machinists, producing for both the domestic and export market. This industry has experienced a decline in employment of 46 percent (2930 workers) since 2002. This is attributed to a combination of increased imports of furniture and a higher New Zealand exchange rate.

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Indicator 6.3.b Average wage rates, annual average income and annual injury rates in major forest employment categories

Nationally, New Zealand workers recorded an inflation adjusted 2.6 percent increase in average hourly earnings between 2010 and 2014 (March quarter figures). In nominal terms, the increase was 11.4 percent. Earnings in both the forestry and wood product manufacturing sectors increased at rates above the national average. In the case of forestry workers, the rise in inflation-adjusted hourly earnings was 15.7 percent, with a significant proportion of this increase occurring in the past two years, due to the rise in harvest volumes and increased labour demand. The wood product manufacturing sector saw hourly earnings increase by an average of 4.2 percent in real terms.

Average hourly earnings in both sectors sit below the national average, but the gap has narrowed over the past four years, particularly for forestry workers. Average hourly earnings in forestry now sit at 84 percent of the national average and 85 percent for wood product manufacturing.

Injury prevention and reduction are critical issues for the forest industry and New Zealand's workplace regulators. The injury claim rate for the primary sector (which includes agriculture and fishing) is more than twice the national average; and 2013 saw a rise in fatalities (reversing a historical downward trend in the 1990s and 2000s).

In response, the industry is working closely with WorkSafe New Zealand and the Accident Compensation Corporation to identify and mitigate the highest risk tasks, and adopt injury prevention and monitoring initiatives. A strong emphasis is placed on recording incidents, to enable companies to learn from past experiences. WorkSafe New Zealand has committed additional resources to addressing injury rates in the industry and is being proactive in assessments and monitoring. The industry commissioned an independent forestry safety review in January 2014 to identify the causes and contributing factors to the rate of serious injury and fatalities occurring within the sector (see Independent Forestry Safety Review, 2014).

Quality of information: H

Progress against indicator: wages ▲ injury rates ▼

Rationale

This indicator provides information on average wage, income and injury rates. These are important aspects of employment quality and the economic value of forests and forest-related employment to communities.

NEW ZEALAND'S REPORT

Average earnings in the forestry and timber processing industries

Moderate growth has occurred in hourly earnings in New Zealand since the previous report. Total hourly earnings increased in nominal terms by an average of $2.90 per hour or 11.5 percent over the 2010 to 2014 period (March year figures), and in real terms by 2.6 percent (adjusted for inflation). This growth has occurred against the back drop of a recovering international economy, improving domestic activity and gains in productivity. Unemployment levels increased in the period following the 2008 global economic crisis, but there is now positive momentum in the job market, leading to labour and skill shortages in several areas.

Wage growth has not been consistent across the board, as every industry has its own set of drivers and constraints. In the case of the log trade, sustained demand from China (and other Asian markets) has resulted in increased harvest volumes and prices over the past four years. This has produced increased demand for logging contractors and associated services. While improving log prices have favoured growers and logging contractors, they have raised input costs for the timber processing sector. The processing sector has also been squeezed by the relatively high New Zealand dollar and constrained demand in key markets for sawn and remanufactured timber.

Average hourly earnings for workers in the forestry and timber processing industries can be tracked over time, using data from New Zealand's Quarterly Employment Survey (Statistics New Zealand, 2014). This survey is managed by Statistics New Zealand and provides quarterly estimates of changes in average hourly earnings (pre-tax); average hours of paid work and the number of filled jobs. The survey covers around 18 000 business locations throughout New Zealand.

Table 6.18 provides average total hourly earnings for workers in the forestry and the wood product manufacturing sectors. The wage data are provided in both nominal and inflation adjusted terms. Workers in the forestry sector have seen strong growth in earnings over the past two years. This rise has substantially exceeded the New Zealand average. Total hourly earnings (which include overtime) increased in nominal terms by $4.83 per hour, or 25.7 percent, between 2010 and 2014. When adjusted for inflation, forestry workers experienced a 15.7 percent increase in real earnings. As discussed previously, the strong growth in export activity over recent years has increased demand for contractors and harvesting gangs and pushed up wage rates. This demand is highly dependent on key markets, such as China. Periods of reduced demand in China can reduce this wage pressure, as seen since the second quarter of 2014.

Earnings in the wood product manufacturing sector increased in nominal terms by $2.79 per hour, or 13.2 percent, between 2010 and 2014. The increase in real terms was 4.2 percent. Wood product manufacturing is a skilled activity, and processors are competing for labour with other sectors of the economy (in particular, other manufacturers and the construction industry). This demand for labour keeps pressure on wage rates.

Both sectors have seen their hourly earnings move closer to the national average. The change has been particularly noticeable in the forestry sector where average hourly earnings have increased from 74 percent to 84 percent of the national average since 2010. The increase for wood product manufacturing has been from 84 percent to 85 percent of the national average.

Average hours of work

The Quarterly Employment Survey provides another important indicator of worker welfare – the average number of paid hours worked by employees. Nationally, the New Zealand labour force worked an average of 38.75 hours a week in the March 2014 quarter. This total included nearly one hour of overtime. Looking at the 2010 to 2014 period, the average working week has changed only marginally.

For the forestry sector, the average number of paid

Table 6.18: Average total hourly earnings for the forestry and timber processing industries

March year	Forestry industry (A03)	
	Average total hourly earnings (nominal figures)	Average total hourly earnings (adjusted to March 2010 figures)
2010	18.80	18.80
2011	20.68	19.80
2012	19.48	18.36
2013	21.36	19.94
2014	23.63	21.75
March year	**Wood product manufacturing (C14)**	
	Average total hourly earnings (nominal figures)	Average total hourly earnings (adjusted to March 2010 figures)
2010	21.17	21.17
2011	21.11	20.21
2012	22.02	20.75
2013	23.99	22.42
2014	23.96	22.05

Notes: 1. "Average total hourly earnings" is equal to "total earnings" (ordinary time plus overtime) divided by "total hours" (ordinary time plus overtime).
2. Figures adjusted using the Consumers Price Index (all groups).
Source: Statistics New Zealand (Quarterly Employment Survey), 2014.

hours worked each week has fluctuated over the past four years, between 37.5 hours and 42.5 hours. This fluctuation reflects varying demand for harvesting services, the availability of crews (particularly new crews coming on stream) and the location of sites.

The average working week for employees in the wood product manufacturing sector is within a narrower band of 38.8 hours to 41.4 hours of paid labour. Part of this variability relates to the level of overtime occurring within the industry.

Overview of the New Zealand occupational health and safety system

New Zealand operates a national accident and injury prevention scheme, which provides cover for all residents and temporary visitors. The scheme covers workplace, sporting and household injuries. The scheme was introduced in 1974 and is administered by the Accident Compensation Corporation (ACC), a Crown agency. Those suffering injuries are entitled to free emergency care, subsidised or free ongoing medical care, compensation for lost earnings and assistance with rehabilitation. In the 2012/13 year, ACC received 1.7 million sporting, household, road and work claims. Of the 178 000 work claims, 1439 were from the forestry sector (Accident Compensation Corporation, 2013).

As well as supporting the injured, ACC has a strong focus on injury prevention and mitigation. In 2014, it introduced a Cross-government Injury Prevention Work Plan, to improve co-ordination with stakeholders and target programmes on priority areas. ACC has developed a range of resources to improve safety practices in the forestry sector and to up-skill contractors and staff. These include training and supervision resources, tools to improve operational and workplace practices and material on the identification of hazards. In the June 2013 year, ACC spent close to $22.4 million on injury prevention schemes, in association with employers, sporting bodies and the like (Accident Compensation Corporation, 2013).

The monitoring and assessment of workplace health and safety was reorganised in late 2013, with the establishment of a stand-alone Crown entity, WorkSafe New Zealand.[37] WorkSafe has a combination of compliance, education and promotion roles. Inspectors from WorkSafe will carry out around 12 500 proactive workplace assessments in 2014 and at least 1000 onsite investigations to assess compliance with the regulations, the need for enforcement or to identify potential causes of harm in the workplace. Alongside these compliance activities, WorkSafe New Zealand is working with industry to improve operational practices and promote dialogue on safety matters (through guidance, education and collaborative initiatives). WorkSafe New Zealand works with several government organisations to ensure workplace practices meet legislative and regulatory standards. These include the New Zealand Police, Maritime New Zealand, Civil Aviation Authority and the New Zealand Transport Agency.

WorkSafe New Zealand has committed additional resources to addressing injury (and fatality) rates in the forestry sector and is being more proactive in assessments and monitoring safety compliance. Between August 2013 and April 2014, it undertook 235 worksite inspections of forestry crews involved in breaking out. Of these inspections, 95 percent were proactive assessments and 5 percent were reactive workplace investigations.

> While many crews are performing well or working hard to meet safety standards, a concerning number are facing challenges... Approximately 50 percent of workplace forestry visits carried out during the breaking out[38] phase have resulted in enforcement activity (i.e. formal warning or notices issued for non-compliance). (WorkSafe New Zealand, 2014a, p6)

Workplace safety in the forestry sector

The forestry working environment can have a high degree of natural risk, due to terrain, slope and climatic conditions. Slope is a particular issue in New Zealand, with a significant proportion of forests located on steeper sites, which cannot be traversed by mechanical harvesting equipment.

> The work requires considerable physicality and technical skill from workers operating where the terrain and working conditions can be difficult.

37 WorkSafe New Zealand assumed the health and safety functions previously carried out by the Ministry of Business, Innovation and Employment and its predecessor the Department of Labour. WorkSafe New Zealand also carries out new functions under the WorkSafe New Zealand Act 2013.

38 Breaking out is the first part of the extraction phase from the felling site. It includes selecting and hooking up the tree stems to be extracted using wire rope or chain

> Plantation forest blocks in New Zealand are often on difficult land... [that]... is frequently steep and can sometime[s] be unstable. (Independent Forestry Safety Review, 2014, p11)

Site preparation, earthworks and harvesting also bring with them operational risks related to the use of heavy machinery and the felling and extraction of logs.

The industry recognises the challenges of the New Zealand forest environment and has been working to ensure that safe operating practices are followed and lessons are learnt from accidents. The focus has been on both reducing operational risks, through improved procedures, training and support, and mitigating the effects of natural conditions. An important issue is the level of manual tree felling due to slope and terrain conditions. The industry (in collaboration with the Government[39]) has a six-year project under way to research innovative harvesting technologies that will improve worker safety and productivity on steeper sites.

Work-related injury claims for forestry accidents are recorded as part of the larger "Agriculture, forestry and fishing" industry category. In 2012, ACC received an average of 201 injury claims for every 1000 full-time equivalent (FTEs) employees in this category. Nearly 90 percent of all claims received by ACC were for one or two visits to a health professional. This reflects the nature of the injuries being recorded. Nationally, 42 percent of all claims involved sprains and strains. A 2008 report by the Centre for Human Factors and Ergonomics showed similar figures for the timber processing sector. "Around 43% of all claims were musculoskeletal disorders, followed by lacerations/puncture/sting, accounting for 22% of all claims" (Ashby and Tappin, 2008, p 1). A relatively small percentage of injuries led to entitlement claims for rehabilitation or weekly compensation. In the agriculture, forestry and fishing industry, an average of 27 entitlement claims per 1000 FTEs were received in the 2008 to 2013 period (Statistics New Zealand, 2013).

The rate of injury claims by workers in these three primary sectors was more than twice the national average.

> The overall rate of injury claims was 93 claims for every 1,000 full-time equivalent employees... Entitlement payments were given in 11 percent (19,000) of all work-related claims. (Statistics New Zealand, 2013, pp 1–2)

In comparison with other sectors, the agriculture, forestry and fishing industry has the highest incidence of injury and entitlement claims on an FTE basis.

Detailed forestry sector data are available for serious harm and fatal incidents, which are notified to WorkSafe New Zealand. The data for the 2008 to 2013 period are shown in Table 6.19. Since 2008, the number of serious harm injuries has fluctuated between 161 and 188 per year. Over this same period, the annual harvest increased by 40 percent, from 20.4 million cubic metres to 28 million cubic metres. Fatal incidents in the forestry sector have reversed a downward trend in the 1990s and the early 2000s, with a spike over the past two years.

> On a per worker basis the forestry sector had the highest rate of fatalities over the last five years.

39 A six-year "Steepland Harvesting Project" started in 2010, under the Government's Primary Growth Partnership.

Table 6.19: Work-related forestry and logging[1] fatalities and serious harm notifications (2008–2013)

Calendar year	Fatal notifications	Serious harm notifications (including fatal)
2008	4	179
2009	5	161
2010	4	170
2011	3	182
2012	6	188
2013	10	Not available[2]

Notes: 1. The figures include the sub-categories of "Forestry support services" and "Services to forestry".
2. Provisional figures for the six months to June 2013 recorded 87 serious harm notifications.
Source: WorkSafe New Zealand, 2013, WorkSafe New Zealand, 2015.

> Tree felling and breaking out are the two highest risk tasks in forestry, with 52% of fatalities attributable to felling, and 31% to breaking-out over the last three years" (WorkSafe New Zealand, 2014a, p 4)

The increase in fatal incidents has led to an industry review of safety and the implementation of new initiatives by WorkSafe New Zealand and other agencies. These initiatives are discussed in the following section. WorkSafe New Zealand has found that while "there is [generally] a strong commitment to safety systems and rules" across the industry, the outcomes on the ground are not meeting industry and community expectations (WorkSafe New Zealand, 2014a, p 3). The priorities for WorkSafe New Zealand are to continue building industry-wide acceptance of responsibility for workplace safety, addressing the main activities that are causing injury and death and supporting the key managers in the supply chain (particularly contractors and crew bosses).

Initiatives to improve forestry workplace safety

In 1984, a national database on logging injuries was established. Companies voluntarily reported the details of injuries sustained, days of work lost and near-miss events. The Accident Reporting Scheme was an important tool for undertaking research on injuries and monitoring the long-term success of prevention measures. Work undertaken by the "Centre for Human Factors and Ergonomics (COHFE) show[ed] the number of lost time injuries per million cubic metres of wood harvested decreased from 23.2 in 1990, to 5.8 in 2002" (New Zealand Forest Owners Association, 2003, p 5). These figures are particularly noteworthy, because the downward trend occurred during a time of increasing harvest volumes and a general move into more difficult terrain.

In 2005, the New Zealand Forest Owners Association, with the support of ACC, launched a web-based Incident Reporting Information System (IRIS). This is an interactive database that enables companies (and the industry as a whole) to benchmark their health and safety performance. The database contains a substantial quantity of information on close calls, which can be used to reinforce (or refine) workplace practices. Periodic improvements have been made to the system (such as a fully searchable library of Safety Alerts), to help owners to avoid similar events.

In 2010, the Department of Labour,[40] in a partnership with ACC and the New Zealand Forest Owners Association, put in place an action plan to address the high injury rate in the forestry sector. The action plan identified tree felling and breaking out as the priority areas for intervention, and the partners have worked with the wider industry to build capability and knowledge in these areas. As a result of the plan of action, the Forest Industries Training and Education Council (now part of Competenz) increased the availability of health and safety training, and a new certification process for breaking out has been introduced. Initiatives were also developed to increase the "culture" of safety within companies and the workforce and to update the Approved Code of Practice for Forestry Operations.

With the establishment of WorkSafe New Zealand, additional resources have been committed to the inspection of forestry operations and the enforcement of safety regulations. WorkSafe New Zealand has increased the number of dedicated inspectors along with identifying new tools and resources for improving education and compliance.

In January 2014, the New Zealand Forest Owners Association, the Forest Industry Contractors Association and the New Zealand Farm Forestry Association initiated an independent forestry safety review to identify the causes and contributing factors to the high rate of serious injury and fatalities occurring in the forestry sector (Independent Forestry Safety Review, 2014). The review team had a broad mandate to look across the sector and its supply chains. This included the regulatory framework, contractual arrangements, working conditions, skills of workers and managers, work practices and equipment. At the time of preparing this report the review team had undertaken extensive consultation and was assessing the findings of submissions.

40 The predecessor organisation to WorkSafe New Zealand.

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Indicator 6.3.c Resilience of forest-dependent communities

The forestry and timber processing industries are important components of regional economic activity, but there are relatively few communities where the sector is the major employer. In most regions, forestry occurs in conjunction with pastoral production and other forms of economic activity, such as tourism and primary sector processing. Nationally, forestry and timber processing accounted for less than 1.4 percent of enterprise employment in 2013.[41] Even in New Zealand's major forestry and timber processing regions (Bay of Plenty, Gisborne, Northland, Tasman and Waikato), the figure was between 3.5 percent and 6.4 percent of enterprise employment.

New Zealand's forestry and timber processing communities have seen significant change over the past 25 years, with the:

- corporatisation and sale of the Crown's commercial forests and processing assets;
- drive to improve productivity and performance (leading to the replacement of labour with capital and technology);
- periods of low log and timber prices, which have seen the closure and restructuring of businesses.

These challenges have seen downward pressure on local employment activity and the loss of key personnel from businesses and districts. Communities have responded by identifying new employment opportunities (often associated with the natural environment, such as tourist tracks) or by putting in place infrastructure to attract new forms of industry. The adjustment process can be a difficult path for communities, with the loss of population and services. Successfully attracting new industry normally involves the community working closely with local and central government agencies.

Rationale

This indicator provides information on the extent to which communities are dependent on forests for their wellbeing, livelihoods, subsistence, quality of life or cultural identity and are able to respond and adapt to social and economic change.

41 This figure includes direct employment in forestry and sawmilling (ANZSIC 06 codes A03, A051 and C141), along with "Other wood product manufacturing" (C149) and "Pulp, paper and converted paper product manufacturing" (C15). This estimate is drawn from the New Zealand Business Demography Statistics, an annual assessment compiled by Statistics New Zealand of economically active enterprises (with a turnover of more than NZ$30 000 (for goods and services tax purposes)).

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The forestry sector contributes at many levels to the economic and social wellbeing of towns and communities throughout New Zealand. The sector has been described as one of the drivers of regional economic activity, because the industry generates significant downstream employment in transportation, retailing and public administration (principally education and health). Modelling by Business and Economic Research Limited (2005; 2008) indicates that this downstream activity can equal or exceed the direct contribution of the industry.[42] A 2013 economic assessment of forestry in the Gisborne (Tairawhiti) region concluded that forestry and related activities generated:

> ...direct revenue of $234 million with approximately $94 million paid out as salaries and wages to Gisborne residents. The associated multiplier of 2.7 suggests a regional economic impact of approximately $631 million. (Institute for Business Research, 2013, p 9).

42 Downstream activity includes indirect and induced economic activity and employment.

One of the characteristics of the forestry sector is the dispersed nature of employment opportunities. Every district in New Zealand (apart from the Chatham Islands) has positions in forestry, logging or downstream wood product manufacturing and processing.[43] This availability of employment is important for attracting families to communities (particularly younger families), and ensuring that local services and community organisations continue to be well supported (for example, sporting clubs and voluntary emergency services, such as the fire brigade). The forestry sector also brings to communities critical skills in management and administration. Management skills are important in smaller communities to guide decision making and foster local leadership.

> Forestry plays a key role in communities such as Gisborne–Tairawhiti, by building economic resilience in rural communities, diversifying economic activity, providing new skills and attracting new and younger workers. (Institute for Business Research, 2013, p 8)

Forestry and timber processing are normally one of several primary sector activities undertaken in rural communities. There are "few rural communities in New Zealand [that] are totally dependent on a single resource sector" (Taylor Baines and Associates, 1999, p 11). Forestry normally sits alongside pastoral production and other primary sector industries, including viticulture, cropping, fishing and mining. This diversity in economic activity provides communities with a more even (and secure) growth trajectory.

The communities with a heavy reliance on forestry and timber processing generally fall into one of three categories:

- communities that were originally established around the harvesting and processing of indigenous timber milling and have made the transition to plantation forestry;
- servicing centres that provide logistical services for forest management and processing (such as transport operators);
- communities that have developed around the maturing exotic plantations established by the then New Zealand Forest Service and private investors since the 1920s.

Māori relationship with the lands and forests of New Zealand

New Zealand's indigenous forests historically provided Māori with a range of basic needs. Forests were a source of food, medicinal herbs and materials for handicrafts and weaving. Communities also harvested selected trees for settlement construction and canoes (waka). Customary practices evolved over the centuries to ensure that forest resources were maintained for future generations and not over-utilised.

> Traditionally, there was a specific custom for the taking or use of any material for basic living, such as food, shelter or clothing. For any of these, a formal ceremony took place. This is [still] valid today for many Māori. A recent occasion involved a ceremony to mark the removal of a tree for the construction of a waka (canoe) by the people of the Taitokerau. (Forest Industries Training and Education Council, undated)

With European settlement, and the introduction of commercial farming and horticulture, Māori reliance on forests for their subsistence needs diminished. Small quantities of food and medicinal herbs continue to be collected by individuals and families. The hunting of feral deer, goats and pigs by individuals and families remains a social and recreational activity for a section of the Māori population. Hunting and commercial trapping provides a livelihood for a small proportion of the Māori and European population. In recent years, there has been growing commercial interest in a number of the herbs and remedies that were traditionally sourced from New Zealand's natural forests (see Indicator 2.e).

Indigenous forests

Māori continue to identify closely with their traditional lands and forests. Of the 1.2 million hectares of privately owned indigenous forest, Māori (through tribal incorporations and trusts) manage more than 400 000 hectares (Miller et al, 2005).[44]

> Currently there are approximately 50,000 hectares of indigenous forest being managed

43 The 2013 New Zealand Business Demography Statistics recorded employment in one or more of the following employment categories in all territorial authorities, apart from the Chatham Islands: A03 (Forestry and logging), A051 (Forestry support services), C141 (Log sawmilling and timber dressing), C149 (Other wood product manufacturing) and C15 (Pulp, paper and converted paper product manufacturing).

44 Almost 80 percent of New Zealand's indigenous forests are now managed by the Crown for conservation purposes.

> under nearly 50 [sustainable forest] management plans, with an allowable annual harvest of 78,000 m^3 standing volume... Approximately 250,000 hectares of indigenous forests have the potential to be sustainably managed. (Ministry for Primary Industries, undated)

Several Māori incorporations have taken the lead in developing sustainable forest management (SFM) plans for their land holdings (under Part 3A of the Forests Act 1949). SFM plans provide for a sustainable annual harvest and detail the protection and management of the forest (including pest control, the regeneration of tree species and areas to be set aside). The allowable harvest is calculated for each species and is within the rate of stand and species replacement.

Māori owners of indigenous forest are also taking initiatives to expand the economic opportunities for indigenous timber species. Research initiatives have looked at marketing and supply chain conditions for species such as beech and tawa. Alongside this work have been initiatives to improve the growth modelling of production species, to improve the technical data behind sustainable harvesting. These initiatives have generally been in association with government funding providers, research agencies and other investors in the indigenous timber industry.

Plantation forests

Māori participation in commercial forestry is significant, through employment, training and land ownership. In a 2012 assessment, the Forest Industries Training and Education Council estimated that 32 percent of the forestry and wood processing labour force was Māori, compared with an average of 12.2 percent across all industries (Forest Industries Training and Education Council, 2012). A similar percentage of Māori were involved in training for forest management, harvesting and timber processing.

The forestry sector has provided an important source of employment for Māori over the past two-to-three generations. The sector has helped to maintain economic activity in rural centres and provided a platform for new Māori enterprises, from silviculture contracting through to harvesting and transport operations.

> The use of independent contractors offers Māori workers opportunities to develop as small business owners, perhaps not so small when a mechanised operation has several million dollars of equipment (Goulding, 2014, p 2).

The availability of forestry employment has also enabled Māori to maintain their association with the land. "Cultural and spiritual links with the land need to be nurtured, and an opportunity to work on the land helps to facilitate this" (Thorp, 2014, p 6).

Māori are playing an increasingly important role in both the ownership of forest land and the management of the forest estate.

In a November 2000 survey, the then Ministry of Agriculture and Forestry estimated that 238 000 hectares of Māori-owned land was in plantation forestry, but only 10 percent of this estate was directly managed by Māori (Miller, et al, 2005). Most of these plantings had been developed through lease agreements (with the Crown or private forestry companies) and were being managed by external parties. This situation has been steadily changing, with Māori incorporations and trusts assuming direct responsibility and management as leases expire. This reflects the growing aspirations of Māori owners to more directly manage their assets.

The settlement of historical Treaty of Waitangi claims is continuing to increase Māori involvement in commercial forestry.

> In total, there are currently around 420,000 hectares of plantation forests on Māori land. By the end of the Treaty claims process this may increase to around 680,000 hectares, or 40 percent of the country's plantation estate. Māori currently own around 80,000 hectares of plantations of which two entities own half... (Thorp, 2014, p 3)

Forestry as a proportion of enterprise employment

The number of communities with a moderate-to-high reliance on forestry, logging and timber processing is relatively small. This can be seen by reviewing recent enterprise employment data. In the February 2013 year, 17 400 people were engaged in forestry and first-stage timber processing. When wood product manufacturing and paperboard production are included, this figure rises to 26 700 people (Ministry for Primary Industries, 2013a). Nationally, this represents less than 1.4 percent of enterprise employment.

The regional distribution of forestry and timber processing employment is largely aligned to the location of the resource. The Bay of Plenty, Gisborne, Northland, Tasman and Waikato regions all have forestry employment levels 1.5 to 4 times the national average (from 2.3 percent to 6.4 percent of the employee count). The Auckland region has an employment level half the national average (0.7 percent of workers), but in absolute terms it is one of the higher employment areas, particularly in wood and paper product manufacturing.

The level of community reliance upon forestry can be seen by looking at the Bay of Plenty region, in the central North Island. While the region employs around a third of the national workforce for forestry and first-stage timber processing, the industry makes up just 4.1 percent of paid employees in the region (Statistics New Zealand, 2014). A breakdown of the region, by area unit,[45] reveals that 98 of the 129 area units[46] (76 percent) had less than 5 percent of their employee count in forestry and timber processing. Only nine of the 129 area units had more than 15 percent of employees in these categories, and just three units had over 33 percent. The area units with the highest rates of forestry employment were those with service communities established during the 1950s and 1960s to meet the labour needs of the maturing exotic forests in the central North Island (along with their associated processing facilities).

An example of one of these centres is the township of Kawerau, in eastern Bay of Plenty. The township was constructed to house the workforce for an integrated sawmill and pulp and paper facility. More than 50 years later, Kawerau still depends heavily upon the mill and its associated industries.

Structural pressures on forestry communities

New Zealand's forestry communities have faced several economic challenges over the past generation, which they have weathered with varying degrees of success. The main developments in this period have been:

- the phasing out of indigenous logging on the Crown estate;
- the corporatisation, and subsequent sale, of the Crown's commercial forests and processing assets;
- the centralisation of public and private services;
- increased technology adoption to improve productivity and competitiveness; and
- periods of low log and timber prices, which have seen the closure and restructuring of businesses.

Reduction in the indigenous timber harvest

The phasing out of indigenous logging from the Crown estate, and the requirement for private landowners to harvest on a sustainable basis,[47] has seen the indigenous harvest progressively decline, from just over 1 million cubic metres of roundwood in 1970 to 15 000 cubic metres in the March 2013 year (Ministry for Primary Industries, 2013b). The decline in indigenous log supplies led to extensive restructuring in this part of industry, from the 1970s through until the turn of the century.

In areas where mills were in close proximity to maturing plantations, there were opportunities to upgrade facilities to process radiata pine. Investors have tended to prefer mill conversions over the development of "greenfield" facilities, as the sites are already designated for industrial activity. This can save considerable time and expense in obtaining planning consents. The move to exotic timber processing has helped to safeguard jobs and, in certain cases, been the springboard for expansion, particularly in the area of further processing.

Where mills have not been able to move into exotic processing or secure sufficient supplies of indigenous timber from sustainably managed blocks, there have been redundancies and mill closures. The response of these communities to plant closures, or to the downsizing of operations, has not been uniform, but there have been several common themes.

The communities, supported by their district councils,[48] have normally undertaken scoping projects to identify alternative employment opportunities

45 Area units are aggregations of mesh blocks with unique names. They are non-administrative areas intermediate between mesh blocks and territorial authorities. Area units must either define or aggregate to define urban areas, rural centres, statistical areas, territorial authorities and regional councils. Each area unit must be a single geographic entity with a unique name.

46 The New Zealand Business Demography Statistics were designed to provide high-quality national-level data. The data frame has limitations at a sub-national level, and the results should be seen as indicative.

47 Sustainable harvesting of indigenous timber from private holdings was introduced through a 1993 amendment to the Forests Act 1949.

48 This support is frequently provided through a development board or community trust.

for their communities. In the case of the Tuatapere community (in western Southland), the Southland District Council helped in developing a concept plan for the township, which built on its heritage sites (Houghton et al, 1996). As a consequence of this report, community funds were invested in developing a major walking track, which has encouraged investment in accommodation and associated tourism and craft activities.

These plans have generally focused on using the historical values of the community and developing tourism activities associated with the natural environment. Communities are also exploring the utilisation of their forested areas for non-timber products, such as honey production, game trophy hunting and wilderness tours. The adjustment communities go through after the closure of a mill can be difficult for individuals and families. The skills of silviculture and processing workers are not necessarily compatible with the new initiatives being developed. Consequently, younger workers have frequently migrated in search of new positions, while older employees have taken early retirement or accepted lesser-skilled positions.

For the wider community, the loss of forestry revenue (through wages and service purchasing) has normally led to a period of economic uncertainty. This persists while new ventures are explored and developed. In the case of tourism bush walks, the planning and development of a track and supporting facilities can take several years.

Corporatisation and centralisation of government services

Another economic challenge for these communities was the corporatisation of the Government's plantation estate, which represented 49 percent of all exotic plantings in 1990. In 1984, these holdings were placed on a purely commercial footing, and. in 1987, were formed into a corporate entity. This led to a rationalisation of staffing, with a number of district offices closing, the contracting out of services and key management functions being centralised. The subsequent sale of the Crown's forestry cutting rights to private investors led to a further rationalisation of management functions.

At a community level, the loss of forestry staff (particularly specialised and highly skilled workers) impacted on leadership roles within these towns and districts. Forestry staff had provided important skill sets for a range of community organisations (for example, accounting and secretarial knowledge). The loss of these skills affected the social and cultural life of these communities (particularly at a sporting and volunteer service level).

In this same period, rural communities were experiencing a loss of services through government corporatisation and private businesses rationalising their business networks (including postal outlets, bank branches and stock and station stores). These developments had significant economic and social ramifications for communities with a heavy reliance on forestry employment. As the forestry and service sector workforce was scaled back, the spending power in these communities declined. Falling disposable incomes had a direct flow-on effect for retail and commercial activity.

> Both the retail sector and other business firms in Murupara were seriously affected by the reduction of the workforces of Tasman Forestry and NZFS [New Zealand Forest Service]... (McClintock and Taylor, 1999, p 31)

> The reduction in employment opportunities impacted particularly on unskilled, older workers, who "do not have the technical skills to work the new technology..." (Taylor Baines and Associates, 1999, p 6).

Productivity and pricing pressures

The heavy dependence of the forestry and timber processing industries on the international market has created an underlying pressure to improve productivity and performance, to maintain the competitiveness of the New Zealand industry against other Pacific Rim countries. Fluctuations in the New Zealand exchange rate, and periods of low commodity prices for logs, sawn timber and other forestry products, have added to the pressure.

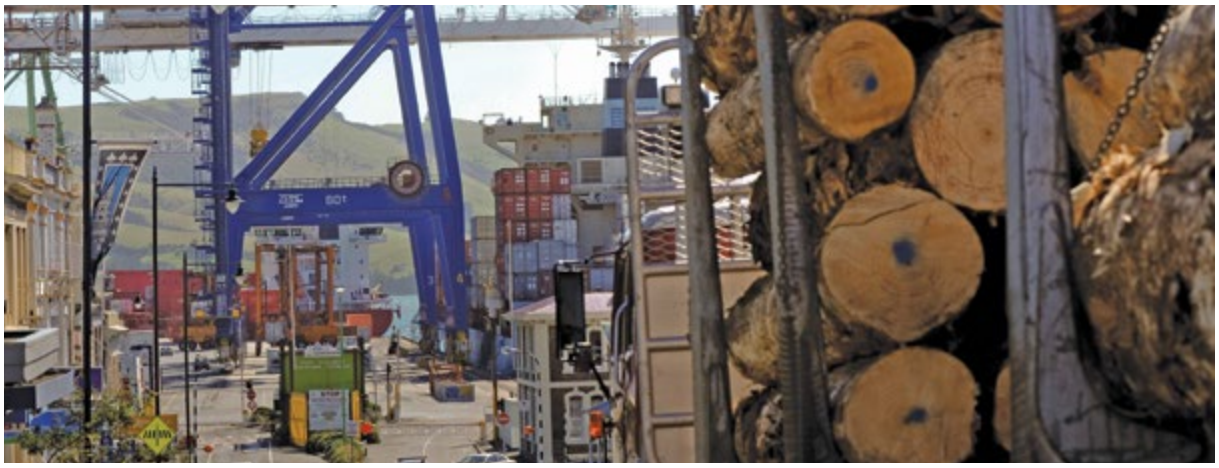
The drive for improved productivity can be seen in both processing and forest management. In the sawmilling sector, larger operators have been steadily moving to higher productivity (and capacity) systems, with scanner optimisation, bin sorters and mechanised stacking processes. The drive for improved efficiency has been seen particularly in the pulp manufacturing industry. The major plants have seen successive rounds of investment over the past 30 years, to achieve production and productivity gains, while lowering unit costs of production. At the harvesting level, improvements in felling and extraction systems have progressively improved the productivity of workers, with a consequential reduction in the labour inputs required.

> The major forestry companies and smaller business units have sought to maintain their profitability by investing in more capital-intensive technology, reorganising their work practices, and reducing the size of their workforces. (McClintock and Taylor, 1999, p 31)

Managerial restructuring has also been seen, with plantation companies merging districts and centralising marketing, harvest planning and technical functions.

These improvements in productivity are maintaining the competiveness of the industry, but they have generally been reducing the labour requirements for forestry and processing operations. This has affected the immediate communities that service these operations. The communities experience a progressive loss of forestry employment over a number of years or decades. This has been seen in communities such as Kawerau, Tokoroa and Murupara in the central North Island.

This employment trend has been moderated in districts with increasing harvest volumes and where processing companies have added additional capacity



or manufacturing activities. As discussed previously, several affected communities (supported by their district councils) have undertaken initiatives to strengthen and diversify their local economies. The initiatives in the central North Island have focused "on adding value to timber by further processing" (McClintock and Taylor, 1999, p 32) or encouraging activities that support the forestry sector. The Kawerau District Council has established a light industrial park, which has attracted businesses that provide support services to the local mill. This initiative has also been successful in attracting business activities from outside of the forestry sector.

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Indicator 6.3.d Area and percent of forests used for subsistence purposes

No communities rely on forests for subsistence purposes in New Zealand, but for some individuals and families the supply of fuel (firewood) and opportunities to hunt deer and pigs for food are important. Traditional Māori medicine uses indigenous plant species.

Quality of information: L

Progress against indicator: ▶

Rationale

This indicator provides information on the extent to which indigenous and other communities rely on forests as a source of basic commodities, such as food, fuel, shelter and medicinal plants. The practice of forest-based subsistence reflects the dependence of rural communities and individuals on forests for essential resources and may be closely linked to cultural identity and quality of life.

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For centuries, Māori made extensive use of the indigenous forest resource for the supply of food, fuel, shelter, clothing and medicinal products. The resource use involved traditional processes of selection, access and removal – requiring the observance of rituals and ceremonies (see Indicator 6.3.c).

No communities rely on forests for subsistence purposes. Nevertheless, the supply of food (for example, meat from wild pigs and deer) and fuel (firewood) from both indigenous and plantation forests are important for some individuals and families, particularly in more remote locations (King et al, 2013). Forests and forestry are important sources of heat energy for the domestic sector. Wood-based fuels account for 7 percent (57.8 petajoules (PJs)) of the country's primary energy supply (Ministry of Business Innovation and Employment, 2013). The main user of wood fuels is the wood processing sector, and the decision to use wood fuel is strictly a commercial one. However, wood fuel also accounts for a little less than half of all the energy used in domestic heating (Isaacs et al, 2006), and a portion of the fuel used in this way is obtained outside the monetised part of the economy.

Traditional Māori medicine (rongoa Māori) involves spiritual healing and the use of herbs from indigenous plants, including tree species. Rongoa Māori is still practised, and scientific studies have supported some of the information about the medicinal use of plants. There is a growing interest in rongoa Māori, and several educational institutions now offer National Certificate of Educational Achievement (NCEA) courses in this field.

The use of the indigenous forest resource by Māori is closely linked to their culture and values. Traditional Māori attitudes to the land, sky, rivers, lakes and seas and the creatures that live in them are based on their knowledge and beliefs about the beginnings of the world.

A revival of interest in community knowledge of the indigenous forest and its fauna and flora is taking place. Māori take wood for carving, vegetable materials for weaving, and feathers of indigenous birds and other materials for traditional purposes. No data are available to indicate the extent to which these uses of forests are undertaken, but in a national context they are limited.

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Manuka tree.

Indicator 6.3.e Distribution of revenues derived from forest management

Information is available on revenues generated by the commercial forest industries and received by government forest agencies. For forest industries in various forms of domestic and overseas private ownership, little information is available on how their revenues are distributed back to communities.

Quality of information: L

Progress against indicator: 

Rationale

This indicator provides information about the flow and distribution of revenues from forest services, management and use back into forest-based communities, wider society and the forest sector. The distribution of those revenues provides information on the extent to which forest-based communities, the forest sector and the wider society share in the economic benefits generated by forests.

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As for Indicator 6.2.a on investment and expenditure, information is available on annual revenue for the commercial forest industries and for revenue received by government. Information is not readily available on revenue from the production of non-wood products or for environmental services from New Zealand's forests.

Commercial forest management and wood-based products

Annual income received by commercial forestry enterprises is influenced by market conditions. Estimates of total income for 2012 and 2006 for major industry categories are provided in Table 6.20.

For "Wood product manufacturing" and "Paper and paper product manufacturing", the income received is all by private enterprises: the group description covers a range of listed and privately owned international and domestic companies.

No information is available on the distribution of profits or dividends. In 2006, some $1241 million was paid in salaries and wages to employees and working proprietors; in 2012, salaries and wages were $1240 million. Purchase and other operating expenses increased from $5129 million in 2006 to $5748 million in 2012 (Statistics New Zealand, 2013). The relatively small change to either compensation of employees or to operating expenses for wood and paper product manufacturing over this five-year period is consistent with the fact that there was little growth to output from either over this period.

For forestry and logging, ownership covers a broad range of overseas-owned timber investment management organisations (TIMOs), listed and privately owned international companies, privately owned domestic companies, partnerships, joint ventures, private investors and central and local government agencies. Again, no data are available on the distribution of profits and dividends, other than from central government owned forests (see below). For salaries and wages to employees and working proprietors, $239 million was paid in 2006 compared with $278 million in 2012. There was

Table 6.20: Total output in 2006 and 2012 financial years by ANZSIC[1] 06 categories ($ million)

ANZSIC category	2006	2012
Forestry and logging	2 810	3 774
Wood product manufacturing	4 627	4 504
Pulp paper and converted paper product manufacturing	2 752	3 337

Note 1: ANZSIC = Australian and New Zealand Standard Industrial Classification.
Source: Statistics New Zealand, 2013.

significant growth in this grouping over the period with intermediate consumption increasing from $1621 million in 2006 to $2425 million in 2012.

State forestry

Crown Forestry (a unit within MPI, but with a significant commercial function), administers the Crown's interest in forestry leases on Māori land, residual Crown forest and other forestry assets. Consistent with government policy, Crown Forestry also seeks opportunities for the Crown to sell its interest in these assets, and works with the Office of Treaty Settlements to resolve Treaty of Waitangi claims over the Crown forestry assets it administers.

Crown Forestry's commercial forestry business will deliver estimated revenues of $115.9 million with expenditure of $96.6 million during 2013/14. Trading surpluses are projected to remain reasonably steady (over $10 million) until about 2020. On the basis of net stocked area, Crown Forestry is currently the seventh largest forest owner in New Zealand.

All Crown Forestry net revenues (after paying whatever contractual obligations are owed to other parties) are paid to the Crown accounts.

The Department of Conservation (DOC) administers the conservation estate, including 5.5 million hectares of indigenous forest and small areas of inherited plantations from which periodic revenues are obtained.

DOC's major source of commercial income is from licences and royalties paid by concessioners operating in the conservation estate and from partnering with businesses. Engagement of the commercial sector in conservation is increasing, with businesses entering new partnerships with DOC and building on established relationships (Department of Conservation, 2013). Total revenue from all concessions and partnerships was only $17.1 million (2011/12) and $18.6 million (2012/13). Reported trends in DOC's financial activity in the 2014 Budget (The Treasury, 2014) indicate that concession and partnership revenue is likely to remain around this level at least until 2017/18 (The Treasury, 2014).

Environmental services

Most environmental services generate little revenue and data are limited.

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INDICATOR 6.4 RECREATION AND TOURISM

Forests have long been used as a place for recreation and other leisure activities. The location and accessibility of forests and the availability of recreational facilities are important to forest-based recreation and tourism. Levels of use are an indication of the extent to which forests are valued by society for these uses.

Indicator 6.4.a Area and percent of forests available and/or managed for public recreation and tourism

Fostering the recreational use of New Zealand's conservation lands (both indigenous forests and grasslands) is one of the principal roles performed by the Department of Conservation (DOC). DOC manages nearly 80 percent of New Zealand's indigenous forests and provides recreational opportunities for all ability and fitness levels. In the 2012/13 year, nearly 43 percent of DOC's total expenditure was devoted to maintaining and developing recreational facilities. This included maintaining 14 000 kilometres of tracks and nearly 1000 huts. The nature of this investment has been changing over time, with DOC tailoring facilities to changing public demands, such as mountain-biking tracks and extreme sport facilities.

Private interests have the opportunity to provide recreational activities within the conservation estate through a formal concession system. These activities include ski fields, guiding and boating operations.

New Zealand's larger plantation companies also provide opportunities for public access, allowing people to undertake activities ranging from hunting and horse trekking to scientific research. Access is normally via a permit system. This enables forestry operations to continue in conjunction with recreational activities.

Quality of information: M

Progress against indicator: ▲

Rationale

This indicator provides information on the area and extent of forests available and/or managed for recreation and tourism activities. The availability and management of forests for these activities is a reflection of society's recognition of the value of forests for recreation and tourism.

NEW ZEALAND'S REPORT

New Zealand's forests, rivers and alpine areas are viewed internationally as offering high-quality adventure and wilderness experiences. The value of these areas (for recreation and conservation) has been recognised for more than a century, and progressive steps have been taken to ensure they are maintained for future generations. New Zealand's first national park, the 79 500 hectare Tongariro National Park, was established in 1887, and three years later the Milford Track in Fiordland was opened. The Milford Track has developed an international reputation amongst wilderness seekers; and the wider Fiordland–South Westland region (Te Waipounamu) has been designated a World Heritage Area.

Nearly 33 percent of New Zealand's land area is formally protected for conservation and recreational purposes (8.8 million hectares out of 26.8 million hectares). Indigenous forests make up a significant proportion of this area. Of the 8.0 million hectares of tall and regenerating indigenous forests, 5.5 million hectares (69 percent) are legally protected for conservation. This is primarily Crown land, but also includes private property that is protected through covenants and other mechanisms.

The protection of New Zealand's natural resources is an ongoing process. In 2002, New Zealand's 14th national park was established, the 157 000 hectare Rakiura National Park on Stewart Island. A recent development has been the establishment of a network of conservation parks in the South Island high country.

The parks protect distinctive areas of biodiversity and provide increased access to the recreational opportunities of the high country.

> The Eyre Mountains/Taka Rā Haka Conservation Park provides unique opportunities for visitors to enjoy a back-country experience in a remote setting… Tramping and climbing options are plentiful within the park and trout fishing opportunities can be found in the rivers on the park boundaries. Hunting, four wheel driving, mountain biking, horse riding, picnicking and camping are also popular options in this remote and scenic landscape. (Department of Conservation, 2007b)

The principal pieces of legislation governing the management of New Zealand's protected lands (the National Parks Act 1980 and Conservation Act 1987) seek to balance the demands of conservation and recreation. Section 4(2)(e) of the National Parks Act 1980 and section 6(d) of the Conservation Act 1987 seek to foster public access and recreation, where activities are not inconsistent with the protection of ecological values and preservation of natural features. The Walking Access Commission, established in 2008, seeks to provide the New Zealand public with free and enduring walking access to the outdoors (including the coastline, lakes and rivers). The Commission provides leadership on walking access issues, and works to resolve disputes on access, as well as negotiate new walking access.

In addition to this legislative commitment, the New Zealand Government has allocated significant resourcing to the maintenance and promotion of recreation and educational facilities in the conservation estate.

Tramping in sub-alpine shrubland, Ruahine Mountains. Photo: Alan Reid.

> In 2002, the Government [announced] a 10-year $349 million programme of work to replace, upgrade and maintain recreation facilities. In the first four years, the additional funds accelerated capital asset replacement, particularly of huts, structures, toilets and roadside facilities for day visitors. Highlights include 42 new backcountry huts since 2002. (Department of Conservation, 2007a)

In the 2012/13 financial year, $138 million was spent on managing recreational opportunities. This represented around 43 percent of DOC's total expenditure of $273 million. This expenditure was used to maintain 13 144 structures, 14 000 kilometres of tracks and 967 huts (Department of Conservation, 2013a).

The types of facilities and services provided by DOC have been changing, in line with visitor preferences. For example, DOC has made a significant investment over the past 15 to 20 years in the development of mountain-biking tracks and facilities for extreme sports.

In 2013, DOC released its 2013 to 2017 *Statement of Intent*. In this document, DOC assessed the changing nature of its visitor profile and identified key outputs to encourage greater participation in outdoor recreation. These outputs include:

- developing icon sites to support the growth in domestic and international visitors;
- developing gateway destinations to grow recreation in the outdoors;
- managing locally treasured destinations to increase community connections; and
- enhancing the backcountry network to attract a wider range of visitors (Department of Conservation, 2013d).

In determining the area available for recreation and tourism, it is important to recognise that activities such as hunting, orienteering and mountain biking are not confined to public conservation lands. The majority of New Zealand's commercial forest owners operate permit systems that allow varying degrees of access to their properties. The permit will detail the type of activity that can be undertaken, the forestry blocks that can be accessed and any restrictions on times and the routes to be used. The permit system enables forestry companies to continue their normal operations while safely allowing a degree of public

access. Some of these recreational activities can have positive benefits for the forestry companies. Recreational hunting for wild deer, pigs and goats, along with the trapping of possums, helps the plantation companies in controlling pest numbers.

The diversity of activities undertaken in the commercial estate can be seen in the permit data of companies such as Blakely Pacific Limited (2007). The recreational activities permitted in its South Island forests include: hunting, cycling, walking, horse trekking and vehicle club access. The growing co-operation between forestry companies and recreational groups can be seen in another Blakely Pacific example. In 2011/12, the company worked with local community groups to re-establish one of the walking tracks in Herbert Forest (North Otago). The track system through Herbert Forest is seen as a significant resource for the local community.

> All of the walking tracks traverse through mature native podocarp forest remnants, the scale of which are rare in the North Otago area. (Blakely Pacific Limited, 2012)

A number of New Zealand's commercial forests have developed into significant tourist attractions in their own right. These forests were generally established by the New Zealand Forest Service (a former state-owned agency). The Forest Service created walkways and supporting facilities in key locations (particularly tourist areas). Most of these facilities have been maintained with the sale of these forests to private interests.

The 5700-hectare Whakarewarewa Forest, near Rotorua, is an important example of a commercial forest that has become a significant recreational resource for local and international visitors. The forest has a network of paths for walkers and joggers; mountain-bike and motorbike tracks; picnic areas and a visitor centre. The forest is managed by Kaingaroa Timberlands,[49] and attracts an estimated 282 000 recreational visits per year (APR Consultants, 2007). In a similar vein, Naseby Forest in Central Otago has gained a national reputation for its mountain-bike tracks. The forest is owned by Ernslaw One Limited, which has supported the recreational development of the forest.

Further examples include the walking and mountain-bike tracks developed around Dunedin by City Forests Limited and the extensive recreational facilities in Woodhill Forest, west of Auckland. Woodhill Forest has grown into a popular recreational resource for the Auckland population, with walking, biking, horse riding and off-road opportunities, as well commercial recreational activities.

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49 Kaingaroa Timberlands manages the forest estate and the land is in Māori ownership. The Redwoods Grove in Whakarewarewa Forest is managed by the Rotorua District Council.

Indicator 6.4.b Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available

New Zealand's indigenous forests and wilderness areas have been attracting visitors for more than 150 years and they now play a central role in the country's domestic and international tourism scene. Nearly 48 percent of New Zealanders (aged over 18) visited public conservation lands in 2012/13, and an estimated 77 percent of international visitors undertook one or more walking, hiking or trekking experiences while they were in the country (June 2013 figures).

The Department of Conservation actively promotes the use of the conservation estate for recreational purposes and has moved to a demand-driven management approach, so it can respond more effectively to domestic and overseas visitor needs.

One of the principal attractions of New Zealand for international visitors is the chance to experience wilderness activities, such as hiking, kayaking and hunting.

Quality of information: H

Progress against indicator: ▲

Rationale

This indicator provides a measure of the level and type of recreation and tourism use in forests. The number and geographic distribution of visits and the facilities available reflect the extent to which people participate in forest-based leisure activities and the importance of forests for recreation and tourism.

NEW ZEALAND'S REPORT

New Zealand's indigenous forests and conservation areas are generally seen as the cornerstone of the country's tourism industry. Domestic and international visitors are drawn by the opportunities to explore wilderness areas and to undertake a range of outdoor adventure pursuits. Providing access to these areas has required long-term investment by central and local government in establishing high-quality walkways, tracks and supporting tourist facilities. In more recent decades, the private sector has taken a larger role in providing recreational facilities and in developing new forms of adventure activity.

> Nature-based tourism ranges from high impact adventure activities such as jet boating, skydiving and mountain climbing to more relaxing activities such as bush walking, wildlife and scenic tours and boat cruises. (Market Economics Limited, 2008, p 1)

The extensive network of tracks that visitors now enjoy has been progressively developed since the late 19th century. The internationally known Milford Track was one of the first to be opened in 1890. The network of tracks was given a major boost in the 1950s and 1960s, when the then New Zealand Forest Service established a system of backcountry tracks and huts, in both conservation and production forests. These tracks opened up the backcountry for recreational and commercial hunters. This was followed in the 1970s and 1980s by a range of government initiatives to upgrade amenities to encourage greater domestic and international use of the conservation estate. New Zealand's focus on wilderness and adventure experiences brings with it a higher level of risk than other forms of tourism. In recognition of this, resources are devoted to the provision of search and rescue, and emergency care services.

When considering the recreation and tourism opportunities associated with New Zealand's forests, it is important not to overlook the role of New Zealand's 1.7 million hectares of commercial plantations. The recreational facilities in these forests are not normally as developed as those in the conservation estate, but they can provide valuable opportunities for bush walks, fishing and hunting. As discussed in Indicator 6.4.a, a number of the long-established commercial forests provide nationally important facilities, such as mountain biking and orienteering tracks.

Visitor trends

New Zealand's indigenous forests have been attracting visitors for more than 150 years. As early as the 1840s, guidebooks were promoting the unique flora and fauna of the country and the opportunities for wilderness experiences. Organised tours soon followed, along with the development of recreational facilities. The establishment of the Hermitage Hotel in 1884 (at the base of Aoraki/Mount Cook) was an early example of this development. The hotel provided a base for guided alpine walks and climbing.

Visitor numbers have grown as the cost of travel (and travel times) has decreased. Large areas of rural New Zealand were opened up to travellers in the 1950s through to the 1970s, with the sealing of district roads. This was coupled with increasing vehicle ownership and the previously mentioned upgrading of the track network. An important development was the advent of long-distance air travel to New Zealand. This enabled New Zealand to become a mass tourism destination. In the mid-1950s, fewer than 100 000 visitors arrived annually. For the year ending December 2013, visitor numbers stood at 2.72 million (Statistics New Zealand, 2014), an 11 percent increase on the 2008 report figure.

The past 10 years have seen a growing recognition that attracting visitors to New Zealand's natural features requires a stronger focus on visitor requirements.

> In order to increase participation, DOC [Department of Conservation] is moving from a supply-based asset management approach to being a demand-driven organisation. This will enable DOC to respond to the recreation needs of New Zealanders and those visiting this country, both now and as demand changes. (Department of Conservation, 2013a)

DOC has also put a strong emphasis on raising public awareness of the conservation estate and the recreational opportunities that are available to individuals and families.

Public use of the conservation estate has risen since the last report. In 2007/08, DOC estimated that 39 percent of adult New Zealanders visited the conservation estate (reserves, national parks and water areas). This increased to 50 percent in 2011/12 and fell back marginally to 48 percent in 2012/13 Department of Conservation 2013c).

Monitoring visitor numbers

Visitor numbers are monitored by DOC and the Ministry of Business, Innovation and Employment through visitor survey programmes. These programmes provide information on the major activities undertaken by domestic and international visitors, such as the number of visits to national parks, tracks and scenic reserves. This helps DOC (and the wider tourism industry) to plan for future demand and identify where natural resources may be under pressure. The data enable DOC to put in place initiatives to:

- meet current and potential visitor needs (with changing demographics and leisure preferences);
- prioritise investment at destinations that have high levels of current or emerging demand; and
- focus development on gateway and iconic sites (Department of Conservation, 2013b)

The visitor estimates produced by DOC are for the entire conservation estate. A separate analysis is not available for indigenous forests, because most reserves combine areas of forest with open grassland, tussock and bush. The International Visitor Survey, managed by the Ministry of Business, Innovation and Employment, asks about visits to specific national parks, but most of the questions, such as walking, overnight trekking and cycling are not specific to a locality.

Table 6.21: Main activity undertaken by New Zealanders during their most recent visit to public conservation land (2010–13)

Main activity	2010/11 (%)	2011/12 (%)	2012/13 (%)
Short walks	29	35	31
Day walks	12	10	16
Camping	4	5	4

Source: Department of Conservation, 2013c, p 52.

Domestic visitors

The latest survey of visitor numbers by DOC found that 48 percent of adult New Zealanders (1.6 million) had visited the conservation estate in 2012/13, and 23 percent of adult New Zealanders had visited a national park (0.8 million).

The principal activity visitors undertake is a short walk, lasting a few minutes to half a day. DOC has placed a high priority on developing short walks for public recreation. The walks have been developed as part of heritage and iconic attractions and are in areas of high visitor use or adjacent to major transport routes.

The relative importance of short walks compared with other activities is shown in Table 6.21. DOC asked visitors the main reason for their last visit to the estate. While the survey numbers vary from year to year, short walks were rated as the major reason in 29 percent to 35 percent of cases (Department of Conservation, 2013c).

Day walks were the principal activity undertaken by 10 percent to 16 percent of survey respondents over the past three years. They are available in most districts, and DOC provides a range of tracks to cater for visitors of varying ability (from easy walking to strenuous). The day-walk tracks range from reserves on the urban fringe to high country parks. Day visitors are generally seeking natural settings for walking, sightseeing, fishing or climbing. One of the more widely known day trips is the Tongariro Crossing in the central North Island. This seven- to eight-hour high-terrain walk attracts over 70 000 visitors a year (Minister of Conservation, 2013).

Camping was the main reason for visiting the conservation estate for between 4 percent and 5 percent of survey respondents. Camping is normally undertaken in conjunction with other recreational activities, such as hiking, hunting and climbing. The camping opportunities range from single, overnight stays in easily accessible sites through to extended high country tracks that can take between three and six days to complete (for example, Routeburn Track – three days, Milford Track – four days and Heaphy Track – four-to-six days). Backcountry fishing and hunting expeditions can last for significantly longer periods.

Of the visitors who stay overnight at campsites or in huts, just over 40 percent are classed as "backcountry adventurers". This group of visitors is seeking the traditional bush or high country experience. They use the more remote tracks and the group includes hunters.

Over the 2010 to 2013 period, 14 percent of adult New Zealanders (0.5 million) stayed in a DOC hut or lodge. The equivalent figures for campsites were 22 percent for basic sites, 18 percent for standard sites and 11 percent for serviced sites. DOC is working to encourage greater use of these facilities and has set five-year targets to steadily increase visitor numbers (Department of Conservation, 2013c).

International visitors

Overseas visitors to New Zealand have increased by 81 percent from 1997 to 2013 (from 1.497 million arrivals to 2.717 million). This growth in visitor numbers has led to a substantial rise in the use of New Zealand's indigenous forests and conservation areas by travellers, as shown in national park data (Table 6.22) below.

The national park data show that overseas visitors are exploring a range of geographical locations, rather than concentrating on one or two particular areas.

Table 6.22: International visitor numbers to selected national parks (1997–2012)

Calendar year	Paparoa (West Coast of the South Island)	Abel Tasman (Upper wSouth Island)	Tongariro (Central North Island)	Aoraki/Mt Cook (Central South Island)	Fiordland (Southern South Island)	Westland (West Coast of the South Island)
1997	11 700	28 800	32 100	154 300	196 100	205 500
2002	44 400	57 900	55 100	158 100	273 000	280 900
2007	97 400	110 700	97 800	172 700	439 900	376 700
2012	114 200	95 300	114 000	155 700	338 700	288 800
Change from 1997 to 2012 (%)	876	231	255	0.9	73	41

Source: Department of Conservation, 2014.

Table 6.23: Nature-based tourism activities undertaken by international and domestic tourists (2008)

Activity	International Occasions	Domestic Occasions
Scenic drive	445 000	582 000
Glacier (walk/view)	325 000	66 000
Sightseeing tour (land)	249 000	352 000
Bush walk (half hour)	248 000	603 000
Bush walk (half day)	225 000	292 000
Trekking/tramping	201 000	315 000

Source: Ministry of Tourism, 2009.

This is reflected in the fact that New Zealand's iconic alpine park (Aoraki/Mount Cook) has seen only a marginal rise in overseas visitor numbers since 1997 (1 percent). The more recently established Paparoa National Park, on the West Coast of the South Island, experienced the greatest percentage gain, with visitor numbers rising 876 percent (from 11 700 to 114 200) between 1997 and 2012.

The weak state of the international economy since 2008 has altered New Zealand's tourist flows, with reductions in long-stay tourists from the United Kingdom and the United States, and increased short-stay arrivals from Australia and China. The shorter trip length has meant that tourists are more restricted in the areas they can visit. This is reflected in the 2012 visitor numbers for parks such as Westland and Fiordland, which require several days to visit (Department of Conservation, 2014).

The principal activities associated with New Zealand's conservation lands are shown in Table 6.23. The activities undertaken by international visitors span a wide spectrum, from strenuous wilderness treks through to passive forms of recreation (such as scenic drives). In addition to this list, 116 000 international visitors undertook fishing and 147 000 kayaking and rafting in 2008 (Ministry of Tourism, 2009). These results show that New Zealand's forests, rivers and alpine landscapes are seen internationally as important tourist destinations, and that visitors travel to the country to undertake a broad range of recreational activities.

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INDICATOR 6.5 CULTURAL, SOCIAL AND SPIRITUAL NEEDS AND VALUES

People and communities, in both rural and urban areas, have a variety of social, cultural and spiritual connections to forests, based on traditions, experiences, beliefs, and other factors. Among them, the spiritual and cultural connections of indigenous people to forests often form part of their identity and livelihood. These values may be deeply held and influence people's attitudes and perspectives towards forests and how they are managed. These indicators provide information on the extent to which cultural, social, and spiritual needs and values exist and are recognized by society.

Indicator 6.5.a Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values

The area of forest land managed by the Department of Conservation (DOC) has increased from 4.9 million hectares in 2000 to 5.5 million hectares in 2014. DOC, in total, has management responsibility for 8.5 million hectares of legally protected lands. All of DOC's lands are managed for conservation purposes under the Conservation Act 1987 and other legislation such as the National Parks Act 1980. Management of DOC's forest land recognises its natural and cultural values. The Resource Management Act 1991 recognises and provides for the relationship of Māori and their culture and traditions in resource management planning by all levels of government.

Quality of information: M

Progress against indicator: ▲

Rationale

This indicator measures the extent of forests managed primarily for their cultural, social and spiritual values to people and communities, including indigenous communities and others with strong ties to forests. The protection of forests to meet such needs and values is a reflection of the extent to which they are recognised by society.

NEW ZEALAND'S REPORT

DOC manages land and forests under the Conservation Act 1987 and other Acts, and under a range of classifications such as national parks, conservation parks, stewardship areas, scenic and other reserves, and wildlife refuges. Under the Conservation Act 1987, all land is managed for conservation purposes. Conservation is interpreted as:

> ...the preservation and protection of natural and historic resources 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. (Section 2, Conservation Act 1987)

DOC consults with Māori and the community about policy, management plans and operations (see Indicator 7.1.a) that relate to land managed under the Conservation Act 1987. Customary use of traditional materials and indigenous species on conservation land may be authorised under various provisions of the Act.

Under the National Parks Act 1980, national parks are to be preserved as far as possible in their natural state.

In 2014, a new model of management for the conservation estate has come into being with the passage of legislation to give substance to the Treaty of Waitangi settlement claim of Ngai Tūhoe. The Te Urewera–Tūhoe Bill provides for Te Urewera (one of the national parks) to be established as a legal identity with its own intrinsic values, and vests the current national park land in that identity. A new Board will be the primary decision maker for Te Urewera and

is charged with governing the land to strengthen the connection between Tūhoe and Te Urewera, preserve its ecosystems and biodiversity and provide for ongoing public use and recreation. The inaugural Board has eight members, four appointed by the Government and four by Tūhoe Te Uru Taumatu (the Tūhoe governance entity). The Board is to select its own chair from among the Tūhoe appointees and, along with the Government and Tūhoe, will work to seek biosphere status from the United Nations Educational, Scientific and Cultural Organization (UNESCO) for Te Urewera.

DOC is also increasing business partnerships and community involvement through community-led projects to support conservation management (see Indicator 7.5.a).

Many private organisations are actively involved in conservation and environmental issues in New Zealand. These vary from local clubs concerned with the protection or restoration of the local environment, to national and international groups concerned with preserving the environment for its ecological, scientific, recreational or scenic values.

As an example, the Royal Forest and Bird Protection Society owns nearly 40 reserves around New Zealand, totalling more than 1000 hectares (Royal Forest and Bird Protection Society of New Zealand, undated).

The protection of important cultural sites, particularly wāhi tapu sites,[50] in the management of plantation forests is provided for through statutory planning processes under the Resource Management Act 1991 (see Indicator 7.1.a). Social values are not generally accorded primary recognition in plantation forest management, though with third-party certification placing emphasis on social values, their incorporation in forest management is increasing.

Management of Māori-owned plantation forests, and of plantation forests on Māori-leased land, commonly gives recognition to Māori customary values.

50 Sacred or sites of special cultural significance to local Maori.

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Indicator 6.5.b The importance of forests to people

Forests are well recognised for a range of natural, cultural, social and economic values. The importance of particular values and mixes of values varies with the nature and location of the forests and with the focus of the group being surveyed. While legislation and policy have largely ended the debate over the protection of natural values of indigenous forests, New Zealand society remains divided on the ability to interact with indigenous ecosystems in sustainable ways.

Quality of information: M

Progress against indicator: ▶

Rationale

This indicator provides information on the range of values that communities and individuals hold for forests. These values shape the way people view forests, including their behaviours and attitudes to all aspects of forest management.

NEW ZEALAND'S REPORT

New Zealanders recognise a wide range of values associated with both indigenous and plantation forests. Most prominent are:

- biodiversity at the species and ecosystem levels, and the ability of ecosystems to function in a healthy state;
- the productive capacity of forests for timber, employment and economic contributions – largely, but not entirely, related to plantation forests;
- access to non-polluted drinking water catchments and waterways;
- the contributions forests make to soil conservation and carbon sinks;
- freedom of access to a variety of passive and active recreational pursuits;
- intrinsic values and their contribution to people's health and wellbeing;
- wild animal recovery and the cultural harvest of plant species;
- landscape features and their contribution to the identity of areas.

These values are based on a review by Barnard et al (2006) who concluded that forest management practices across public and private tenures account for the values inconsistently. Many are "public" values, such as biodiversity, landscape and water quality. Consequently, forest management on publicly and privately owned land attracts considerable public interest.

The purpose of management of publicly owned indigenous forests under the Conservation Act 1987 is to maintain their intrinsic values (see Indicator 6.5.a).

Sustainable forest management of privately owned indigenous forests under Part 3A of the Forests Act 1949 requires the management of the forest land in a way that maintains the ability of the forest to continue to provide a full range of products and amenities in perpetuity, while retaining the forest's natural values. The passing of this legislation in 1993, and the decision by government to halt harvesting from publicly owned indigenous forest from 2002, ended much of the debate over the protection of the natural values of indigenous forests.

Plantation forests are recognised for their commercial value in the production of wood and processed wood products, and for employment. They also contribute to sustainable economic development, to carbon sequestration and storage, and enable the setting aside of indigenous forests from commercial wood production.

New Zealand's forests are highly valued for recreational purposes including tramping (trekking), bushwalking, camping, wildlife appreciation, photography, mountain biking and hunting (see Indicator 6.4.b). They are also widely used for community activities and school educational visits.

This recognition of the values of forest ecosystems, both indigenous and plantation, is obvious in several chapters in the book *New Zealand ecosystem services* (Dymond, 2013).

Māori have strong cultural, spiritual and commercial

connections to forests and forestry. They are connected spiritually and culturally with indigenous forests as a resource for food, medicines, building materials, shelter, clothing, implements and handicrafts (Harmsworth and Awatere, 2013). Māori involvement in plantation forestry is steadily increasing and provides an option for the protection of Māori lands, employment and economic benefits.

In the management of plantation forests, Māori have historically adhered to the basic customary principles and beliefs that form Māori customary law. In managing the Māori lease plantation forests of Lake Taupo and Lake Rotoaira, the first three objectives of each lease require the:

- maintenance of soil stability and prevention of erosion to protect the streams, rivers and lakes;
- protection of wildlife and fish habitat;
- protection of wāhi tapu (sacred or sites of special cultural significance of locala Māori) on the lands.

The Parliamentary Commissioner for the Environment's 2002 report *Weaving resilience into our working lands* identifies the clash of values over what New Zealand should do with indigenous plants growing, or planted, on privately owned land. The report states:

> At the core of the debate regarding the future roles of native plants on private land is a fundamental difference of view concerning the ability of New Zealanders to interact with indigenous ecosystems in ecologically sustainable ways. There is an inherent tension in human efforts to manage natural resources. This tension is most immediately evident in the conflicts between values of utilisation and protection, between monetary returns and ecological constraints. The inability of New Zealanders to reconcile these conflicts has created a significant split in the purposes for which we manage land …
>
> As illustrated, land management in New Zealand can be characterised by a dichotomy [sic] between:
> - nature and culture (society)
> - public and private
> - indigenous and exotic
> - conservation and production
> - protection and exploitation.
>
> (Parliamentary Commissioner for the Environment, 2002, pp 15–16)

This indicates that New Zealand society is divided on how well the values of indigenous vegetation are appreciated, and questions whether the nation has yet developed the ability to manage indigenous resources for productive purposes, while protecting their natural values.

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CRITERION 7:
LEGAL, INSTITUTIONAL AND ECONOMIC FRAMEWORK FOR FOREST CONSERVATION AND SUSTAINABLE MANAGEMENT

Criterion Seven relates to the overall economic, legal, institutional, and policy environment of a country. This Criterion provides a context for the consideration of Criteria One to Six.

Legislation, institutional capacity and economic arrangements, with associated policy measures at both national and sub-national levels, create an enabling environment for the sustainable management of forests. Reporting against these indicators contributes to raising public and political awareness of issues affecting forests and builds support for their sustainable management.

Table 7.1 lists the indicators covered in this section.

Table 7.1: Indicators for Criterion 7 – quality of information and trends

Criterion 7: Legal, institutional and economic framework for forest conservation and sustainable management		Quality of information	Trend
7.1.a	Legislation and policies supporting the sustainable management of forests	H	▶
7.1.b	Cross-sectoral policy and programme co-ordination	H	▶
7.2.a	Taxation and other economic strategies that affect sustainable management of forests	H	▶
7.3.a	Clarity and security of land and resource tenure and property rights	H	▲
7.3.b	Enforcement of laws related to forests	H	▶
7.4.a	Programmes, services and other resources supporting the sustainable management of forests	H	▶
7.4.b	Development and application of research and technologies for the sustainable management of forests	H	▲
7.5.a	Partnerships to promote the sustainable management of forests	H	▲
7.5.b	Public participation and conflict resolution in forest-related decision making	M	▲
7.5.c	Monitoring, assessment and reporting on progress towards sustainable management of forests	M/H	▲

KEY

L = low	Neutral ▶
M = medium	Positive ▲
H = high	Negative ▼

NEW ZEALAND OVERVIEW

Key initiatives since 2008 are the:

- introduction to Parliament of the Environmental Reporting Bill to provide a national-level environmental reporting system;
- introduction of the New Zealand Emissions Trading Scheme to address greenhouse gas emissions and removals;
- publication of the National Infrastructure Plan 2011 and the 2012–15 National Land Transport Programme;
- review by WorkSafe New Zealand in to safety in the forest industry;
- introduction of a forest growers levy to fund a variety of plantation forest industry-good initiatives;
- release of version 4 of the national Land Cover Database.

Legal framework

The Treaty of Waitangi is the foundation legal document that enshrines the partnership between New Zealand's indigenous Māori people and the Crown, and recognises the rights of Māori. Its principles are recognised in key resource management legislation.

The Resource Management Act 1991 (RMA) is the primary legislation for the statutory management planning of land, air and water resources. The purpose of the RMA is to promote the sustainable management of natural and physical resources while (amongst other things) avoiding, remedying or mitigating adverse effects of activities on the environment. Much of the responsibility for implementation of the RMA has been devolved to local government (regional, district and city councils), principally through the development of a range of policy statements and plans.

New Zealand has a well established and robust legal framework for the identification and protection of property rights, particularly through the Property Law Act 1952 and the RMA.

Biosecurity is an important issue for New Zealand, as the country is free of many overseas forest (and other) pests and diseases. With increasing trade and travel elevating the risks of incursions, a strong biosecurity system is crucial. This is delivered under the Biosecurity Act 1993, with the system focused on risk reduction, readiness, response and recovery.

Public participation is provided for in:

- legislative Bills progressed through a Parliamentary select committee process that provides for public participation, with the exception of those Bills requiring urgency;
- the development of local authority policy statements and plans under the RMA.

For members of the public to have effective input to legislative and planning processes, access to good information is essential. A variety of forestry information is available (see below under Institutional framework). The Official Information Act 1982 and Local Government Official Information and Meetings Act 1987 operate on the principle that government information shall be made available unless there is good reason for withholding it.

The Parliamentary Commissioner for the Environment is an independent Officer of Parliament under the Environment Act 1986 with wide powers to investigate, report and make recommendations to Parliament on any environmental matter. The Parliamentary Commissioner for the Environment can also investigate and advise public authorities on the effectiveness of environmental management.

At the forest level, the Conservation Act 1987 requires the Department of Conservation (DOC) to develop conservation management strategies for the integrated management of natural and historic resources, including the Crown-owned indigenous forests. Sustainable forest management plans and permits are required under the Forests Act 1949 where timber is harvested from privately owned indigenous forests.

Forestry, resource management and biosecurity legislation and regulations are enforced by specialist staff from central and local government, as well as by honorary rangers for the conservation forest estate. The legislation includes penalties for offences that provide for fines and imprisonment, while the RMA also provides for enforcement orders and abatement notices.

Dispute resolution mechanisms include arbitration, mediation, the Small Claims Tribunal and the courts.

Policy framework

Governments over the past two decades have taken a cross-sector or landscape approach to resource

management. Current approaches seek to manage adverse effects on the environment, while balancing sustainable resource use. The legislative and economic frameworks mean investment is largely market driven.

The RMA delivers resource management planning at central, regional and district government levels that directly affects many forestry activities.

Conservation management strategies cover the Crown-owned indigenous forest conservation estate, and more detailed conservation management plans may be prepared. About 84 000 hectares of privately owned indigenous forest are under registered sustainable forest management plans or permits (see indicators 2.a and 2.d). Large-scale plantation forest owners also undertake estate, forest and/or operational levels of planning.

Institutional framework

Well-developed road, rail, port and energy infrastructure networks generally serve the needs of the forest industries. Central and local government operate the public road network, and central government purchased the assets of the national rail operator in 2008. Overseas trade relies heavily on sea transport, and New Zealand is served by 13 commercial ports with significant volumes of forestry exports and/or imports. Central government strategies are in place to provide for the continuing development of this infrastructure.

New Zealand has several Crown Research Institutes, universities, private companies and individuals providing forestry or forestry-related research. For the indigenous forest estate, the research is focused on biodiversity and the management of introduced pests. Research on sustainable plantation forest management is extensive and wide ranging.

New Zealand has well-developed systems of forestry training and education, delivered through Competenz (an industry training organisation), polytechnics, universities and private training providers.

DOC is increasing business partnerships and community involvement through community-led projects. DOC also engages with the public through visitor centres, volunteer programmes, conservation projects, annual events, educational resources, discussion documents, surveys and access to website-based resources.

Comprehensive statistical databases are available that describe the plantation forest estate, the production of, and trade in, wood and wood products. Forecasts of plantation forest wood availability are prepared about every five years. The reliability of this information is supported by the generally strong commitment of forest owners and processors of wood products to provide detailed statistical information.

Information on the extent and physical attributes of indigenous forests is being strengthened as a result of international climate change reporting requirements and the use of satellite imagery. These requirements, and the application of revised survey methods and the auditing of a percentage of the monitoring on conservation estate land, are raising the reliability of data available for the indigenous forest estate.

Economic framework

The main forms of taxation that affect forestry are company and income tax, and goods and services tax. The taxation regime applying to commercial forestry has been stable since 1991, when significant changes were made to the income tax legislation applying to forestry. The taxation rate for businesses in New Zealand decreased from 30 percent to 28 percent in 2011, while the goods and services tax increased from 12.5 percent to 15 percent in 2010.

Investment in commercial forestry is influenced by a range of business and market-related factors. The New Zealand Government is supportive of foreign investment. The Overseas Investment Act 2005 regulates overseas acquisitions of New Zealand land and significant business assets.

The New Zealand economy is highly dependent on international trade of primary products, with forestry the third-highest export earner. New Zealand operates a relatively open trade policy and actively engages in trade liberalisation. Over recent years, it has become a party to several regional bilateral and plurilateral trade agreements.

Indicator 7.1.a Legislation and policies supporting the sustainable management of forests

New Zealand has a well established and robust legal framework supporting the sustainable management of resources, including forests. It includes the Resource Management Act 1991 (RMA), Conservation Act 1987, Forests Act 1949 and Biosecurity Act 1993. The Treaty of Waitangi recognises the rights of Māori and their partnership with the Crown.

An indigenous forest policy established in 1991 resulted in the sustainable (indigenous) forest management provisions of the Forests Act 1949.

Since 2008, amendments have been made to the Resource Management Act 1991 and further amendments are before Parliament.

Rationale

This indicator provides information on legislation and policies, including regulation and programmes, which govern and guide forest management, operations and use. Legislation and policies designed to conserve and improve forest functions and values are prerequisite to achieving the sustainable management of forests.

NEW ZEALAND'S REPORT

Treaty of Waitangi

The Treaty of Waitangi was signed in 1840 and is the foundation legal document that recognises the rights of Māori in New Zealand and their partnership with the Crown. Its principles (see **http://www.justice.govt.nz/tribunals/waitangi-tribunal**) are provided for in many pieces of legislation, including the RMA[51] and Conservation Act 1987.

The Waitangi Tribunal is the judicial body that considers claims from Māori who believe that they are prejudiced by government action inconsistent with the Treaty of Waitangi. The Tribunal was established by the Treaty of Waitangi Act 1975. It is a permanent commission of inquiry, charged with making recommendations on claims brought by Māori relating to acts or omissions of the Crown that breach the promises made in the Treaty of Waitangi (see **http://www.justice.govt.nz/tribunals/waitangi-tribunal/the-claims-process**). Many claims relate to the return of resources held by the Crown. Land subject to a claim has its title annotated accordingly so that the claim is not affected should the land be sold.

Resource Management Act 1991

The RMA is the primary legislation for statutory resource management planning, having brought together laws governing land, air and water resources.

The RMA has been under review since 2008 to simplify and streamline planning processes. The second phase of amendments is currently under consideration through the Resource Management Reform Bill 2012.

The purpose of the RMA (section 5) is "...to promote the sustainable management of natural and physical resources". Sustainable management is described in (section 5(2)) as:

> ...managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—
>
> a. sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
>
> b. safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

51 Under section 6(e) of the Resource Management Act 1991, the relationship of Māori with their ancestral lands, water, sites and treasured resources is a matter of national importance, to be recognised and provided for by all who exercise functions under that Act. The principles of the Treaty of Waitangi must also be taken into account in managing the use, development and protection of natural and physical resources (section 8).

c. avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Matters of national importance are also identified in the RMA (section 6) and these must be recognised and provided for by those parties implementing the legislation. They currently include the:

- protection of outstanding natural features and landscapes from inappropriate subdivision, use and development;
- protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;
- relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu[52], and other taonga[53];
- protection of historic heritage from inappropriate subdivision, use and development;
- protection of recognised customary activities.

Other matters that those implementing the legislation must currently have regard to (section 7) include:

- kaitiakitanga;[54]
- the ethic of stewardship;
- the maintenance and enhancement of amenity values;
- intrinsic values of ecosystems;
- maintenance and enhancement of the quality of the environment.

Amendments being considered propose to delete some matters in sections 6 and 7, add new matters, and merge into one list matters of national importance. Also proposed is a new section 7 that will set expectations of best-practice approaches to resource management decisions.

Central government has devolved much of the responsibility for resource management planning and policy making to local government through the RMA. Every regional council must have a regional policy statement with which regional and district plans must be consistent. Such statements provide an overview of the resource management issues of the region, as well as policies and methods to achieve integrated management of the natural and physical resources of the whole region. Regional and district plans help councils carry out their functions in order to achieve the purpose of the RMA. All policy statements, and regional and district plans, must be reviewed every 10 years.

To provide direction to local government, central government can prepare national policy statements (such as the Proposed National Policy Statement on Indigenous Biodiversity, New Zealand Coastal Policy Statement 2010, and National Policy Statement for Freshwater Management 2014) and national environmental standards.

District and regional councils have taken differing planning approaches to manage plantation forestry activities under the RMA. This differing treatment of forestry activities is being addressed under a proposed National Environmental Standard for Plantation Forestry. The standard is being developed jointly with industry, councils and environmental non-government organisations. It is proposed that it will cover the key plantation forestry activities including harvesting and earthworks, and it is intended to improve certainty for forest owners.

Local Government Act 2002

The Local Government Act 2002 requires regional, district and city councils to develop community outcomes and translate these into long-term community plans. These are 10-year strategic planning documents covering all functions of local government. They do not override the provisions of RMA plans but are expected to inform the preparation of plans prepared under the RMA.

Biosecurity Act 1993

Central and regional government agencies administer functions under the Biosecurity Act 1993. The Act provides a framework to manage pests and unwanted organisms in New Zealand along a continuum from pre-border activities through to incursion response and long-term control and containment. The work is led and co-ordinated by the Ministry for Primary Industries.

An effective biosecurity system is crucial to protect the environment, the economy and human health. New Zealand's biosecurity system is based on the Biosecurity Act 1993 and on four basic steps that reduce the potential or actual impact of a new and unwanted organism:

52 Wāhi tapu means land of special spiritual, culturual or historical tribal significance.

53 Taonga means a treasure.

54 Kaitiakitanga means the exercise of guardianship by Māori in relation to natural and physical resources.

- risk reduction involves identifying, analysing and eliminating or mitigating risks (offshore and border biosecurity measures);
- readiness is about preparedness for future events;
- response involves actions taken after an incursion event;
- recovery comprises the co-ordinated mid- and long-term efforts to restore or mitigate the social, economic, natural and built environments.

Forest biosecurity is strengthened through collaboration with the sector and other stakeholders. Particularly relevant are the Forest Biosecurity Consultative Committee, the Surveillance Incursion Response Working Group and the Forest Research Biosecurity Council.

Conservation Act 1987

The Conservation Act 1987 requires the Department of Conservation (DOC) to manage for conservation purposes, all land, and all other natural and historic resources held under the Act. This includes about 5.5 million hectares of indigenous forest. Section 2 of the Act defines conservation as:

> …the preservation and protection of natural and historic resources 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 Act requires DOC to develop conservation management strategies in accordance with the legislation under which it operates. The purpose of these strategies is to implement general policies and establish objectives for the integrated management of natural and historic resources managed by DOC, and for recreation, tourism and other conservation purposes. For areas where there are high levels of activity or complexity that cannot be satisfactorily dealt with by a conservation management strategy, a more detailed conservation management plan may be prepared.

A conservation management plan must be prepared under the National Parks Act 1980 for each national park, and be reviewed at least every 10 years. Under the Act, national parks shall be preserved as far as possible in their natural state.

Forests Act 1949

An amendment in 1993 introduced Part 3A (provisions relating to indigenous forests) to the Forests Act 1949. Part 3A requires sustainable forest management plans or permits approved by the Ministry for Primary Industries for the commercial harvesting of timber from most privately owned indigenous forest, the registration of all sawmills processing indigenous timber, and controls the export of indigenous timber.

The purpose of Part 3A is to promote the sustainable management of indigenous forest land. Sustainable forest management is defined (section 7) as:

> …the management of an area of indigenous forest land in a way that maintains the ability of the forest growing on that land to continue to provide a full range of products and amenities in perpetuity while retaining the forest's natural values.

Independent Officers of Parliament

The Parliamentary Commissioner for the Environment (PCE) is an independent Officer of Parliament under the Environment Act 1986. The PCE aims to maintain and improve the quality of New Zealand's environment, with a focus on sustainability. The PCE has wide powers to investigate, to report findings and to make recommendations to Parliament on any matter where the environment may be, or has been, adversely affected. The Parliamentary Commissioner investigates and advises public authorities on the effectiveness of environmental planning and management.

Under the Ombudsmen Act 1975, an Ombudsman can investigate any decision, recommendation or action affecting any person or body of people undertaken by public service departments. An Ombudsman may report and make recommendations on complaints.

Policies

Government policy approach to primary sector management is cross-sector or landscape-based, with a focus on balancing environmental and economic outcomes. Government seeks to manage adverse effects on the environment while ensuring resource use is sustainable. This cross-sector and effects-based approach to resource management means a forestry policy is not considered appropriate by

the Government[55]. Investment decisions are largely market driven. These frameworks can result in land use change among primary sectors, including some conversion of plantation forest to pastoral farming where farming is more profitable.

The Wood Council of New Zealand's Strategic Action Plan (WoodCo, 2012) has a target to more than double forest and wood product exports to $12 billion by 2022. Government and industry are working jointly to realise the potential of engineered wood products to add value to the forestry industry, and to contribute to growing the value of the country's forestry exports.

A Conservation General Policy and allied General Policy for National Parks are operative and guide the conservation of New Zealand's natural and historic heritage.

A 1990 National Indigenous Forest Policy provides the basis for the Part 3A provisions of the Forests Act 1949 that control the harvesting and milling of timber from privately owned indigenous forests (sustainable forest management). An amendment to this policy resulted in the cessation of all harvesting from indigenous forests on Crown-owned land in 2002, with the exception of 12 000 hectares. Cyclone Ita caused widespread wind-throw in indigenous forests on the West Coast in 2014, and recovery of some of these trees over a five-year period has been enabled.

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55 A sector project to develop a forestry policy was initiated in 2014.

Indicator 7.1.b Cross-sectoral policy and programme co-ordination

Sustainable resource management in New Zealand seeks to balance the adverse effects on the environment, while ensuring the sustainable use of resources. The Resource Management Act 1991 focuses on the integrated management of natural and physical resources.

The legislative and economic frameworks mean that investment decisions are largely market driven.

From 2008, the New Zealand Emissions Trading Scheme has been operative across most sectors of the economy to address greenhouse gas emissions and removals.

Rationale

This indicator provides information on the extent to which policies and programmes are coordinated across sectors to support the sustainable management of forests. Non-forest sector land use and development decisions may have a significant impact on forests and their use. Cross-sector coordination of forest and non-forest related policies and programmes can promote improved forest management by helping to minimise adverse impacts and by strengthening the ability of countries to respond to national and global issues.

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Sector policies and programmes

Government policy approach to primary sector management is cross-sector or landscape-based, with a focus on balancing environmental and economic outcomes. Government seeks to manage adverse effects on the environment while ensuring resource use is sustainable. This cross-sector and effects-based approach to resource management means a forestry policy is not considered appropriate by the Government. Investment decisions are largely market driven. These frameworks can result in some land use change among primary sectors, including conversion of plantation forest to pastoral farming where farming is more profitable.

The sustainable management of natural resources, and the sectors they support, is addressed during the development and review of regional policy statements and regional and district plans under the Resource Management Act 1991 (RMA). The RMA has a strong focus on the "integrated management" of the natural and physical resources of a region or district.

The procedures for preparing policy statements and plans incorporate formal (as set out in the legislation) and informal consultation processes. Public submissions must be called for during the drafting of policy statements and plans. Consultation with affected parties may also be required before resource consents for specific activities are granted or declined. Any submitter who is not satisfied with a council's decision may appeal to the Environment Court, and then to the High Court (on points of law).

The RMA requires the Minister for the Environment to monitor the effect and implementation of the legislation. The Act also requires every regional and district council to monitor the state of the whole or any part of the environment of its region or district. It does so to the extent that is appropriate to enable the local authority to carry out its functions effectively under the Act. Regional and district councils are also required to respond to complaints and, where necessary, take enforcement action. Such action may include infringement and abatement notices, enforcement orders and prosecutions (see Indicator 7.3.b).

Non-forest sector land use

The clearance of forest and development of pastoral agriculture by early settlers has resulted in significant areas of land with moderate to severe, actual or

potential, soil erosion. Reforestation and other soil erosion mitigation measures are needed. The current cost of purchasing much of this land does not reflect its sustainable use (for example, few regulatory land use controls exist on soil erosion) and is an impediment to the establishment of new plantation forests or regeneration to indigenous forests. Policies to address wider environmental impacts (e.g. nutrient limits) or allocate environmental goods (e.g. water) can also impact land use-options, though the affect this has on forests is ambiguous.

Responding to national and global issues

The New Zealand Emissions Trading Scheme (ETS) is the primary mechanism for the country to reduce greenhouse gas emissions and meet international commitments. It puts a price on emissions from most sectors of the economy and a value on carbon sequestration and storage to change behaviours through a market mechanism. For the past three years (2012–2014), the value of New Zealand Units (carbon credits) traded under the ETS has reflected the low international price and has provided little incentive for tree planting. (See also indicators 6.1.c and 6.2.a.)

The establishment of substantial areas of plantation forests during the 1990s that are maturing, sequestering and storing carbon has enabled New Zealand to offset its greenhouse gas emissions from other sectors of the economy, for example, agriculture and transport.

New Zealand's strategy for implementing the Convention on Biological Diversity is outlined in the New Zealand Biodiversity Strategy. The Department of Conservation co-ordinates implementation of this strategy. The international reporting period 2009–2013 is covered in New Zealand's Fifth National Report to the United Nations Convention on Biological Diversity, which provides information on the nature and extent of implementation and progress towards the 2020 Aichi Biodiversity Targets.

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Indigenous forest remnants and poplar/willow erosion control planting on farmland, East Coast of the North Island.
Photo: Alan Reid.

Indicator 7.2.a Taxation and other economic strategies that affect sustainable management of forests

The commercial forestry taxation regime has been stable since 1991. The goods and services tax increased from 12.5 percent to 15 percent in 2010, while the general company income tax rate was reduced from 30 percent to 28 percent in 2011.

The New Zealand Government is open to foreign investment, and regulations are liberal by international standards. The Overseas Investment Act 2005 regulates overseas acquisitions in New Zealand land and significant business assets.

New Zealand has a liberal trade policy and engages in trade liberalisation forums. It is a party to several regional bilateral and plurilateral trade agreements.

Rationale

This indicator provides information on the economic strategies that affect the sustainable management of forests. Government policies and strategies on investment, taxation and trade may influence both forest management and the level of long term investment in forestry.

NEW ZEALAND'S REPORT

Taxation

The main forms of taxation that affect forestry are income tax and goods and services tax (GST). The income tax rate for all companies in New Zealand was reduced from 30 percent to 28 percent from 1 April 2011 and applies to net income after allowable deductions.

The current income tax regime for forestry has applied since 1991. For taxation purposes, expenditure by a forestry business falls within three categories:

- capital expenditure that is never deducted and depreciated for tax purposes, for example, land purchase;
- expenses of a capital nature expended on an asset with a limited life, for example, construction of fences, roads and firebreaks; these can be depreciated against income from any source;
- costs directly related to the tree crop or incurred in the maintenance of the forestry business, for example, for planting, tending, pest control and overheads; these are deductible in the year incurred from income from any source.

When standing timber is sold in conjunction with land or other assets, the portion of the sales value assigned to the tree crop is treated as part of the seller's assessable income for taxation purposes. The purchaser needs to record the part of the sale price that is immature timber and is able to claim this as a deduction on the eventual sale of that timber.

All personal income, other than most capital gains, is taxed at varying rates that depend on the level of income (with the highest rate being 33 percent).

GST is a value-added tax that applies to goods and services supplied by GST-registered people. The GST rate was increased from 12.5 percent to 15 percent on 1 October 2010.

Investment

The New Zealand Government is open to foreign investment. Regulations governing foreign investment are liberal by international standards, with targeted investment restrictions in only a few areas of critical interest.

Historically secure property rights, an independent, transparent and efficient legal system and lack of corruption, all favour long-term investment in the New Zealand forest industries. General factors that influence investment decisions in forest growing and wood processing include:

- operating costs, capital costs, size of margins and the return on capital;
- availability of labour with the required skills;

- taxation regimes;
- environmental legislation and performance requirements;
- infrastructure.

Investment in the forest growing and wood processing industries can be made in several ways, giving flexibility for investors. Mechanisms include:

- direct investment, such as through the purchase of land, forestry cutting rights or processing facilities;
- joint ventures facilitated through the Forestry Rights Registration Act 1983;
- shares in forestry companies;
- investment companies;
- partnerships.

Foreign direct investment

The Overseas Investment Office administers the New Zealand Government's foreign investment policies, the Overseas Investment Act 2005 and the Overseas Investment Regulations 2005. The Act regulates the acquisition by oversees entities of 25 percent or more ownership or control of interests in significant business assets, and sensitive New Zealand land, which includes:

- non-urban land greater than 5 hectares;
- land on identified offshore islands greater than 0.4 of a hectare;
- land greater than 0.4 of a hectare that is held for conservation purposes under the Conservation Act 1987;
- land greater than 0.4 of a hectare subject to a heritage order;
- registered historic places, historic areas, wāhi tapu (sacred or sites of special cultural significance to local Māori) or wāhi tapu areas.

Consent to acquire sensitive land is only granted if the transaction will, or is likely to, benefit New Zealand, or the relevant overseas person intends to reside in New Zealand indefinitely.

Significant business assets arise where the value of the assets exceeds $100 million.

The Act identifies criteria for consents for overseas investments in land and in significant business assets.

There are no restrictions on the movement of funds into or out of New Zealand, or on repatriation of profits. No additional performance measures are imposed on foreign-owned enterprises.

Trade

Trade is critical to New Zealand's economy, with exports contributing about 30 percent to gross domestic product (GDP). Primary products (agriculture, fisheries, forestry) contributed 73 percent of the value of all merchandise exports, and forestry products contributed 10.3 percent in the year ended December 2013 (Statistics New Zealand, 2014).

New Zealand operates a relatively open trade policy, having removed trade-distorting subsidies on primary products, and is promoting similar liberalisation in international trade.

Historically, forest products have not been subject to the same sensitivities in trade as agricultural products, but restrictions include:

- tariff escalation, where tariffs rise in line with the amount of added-value processing of a traded product;
- non-tariff barriers that include a variety of trade restricting measures imposed by trading countries, such as biosecurity or product certification measures.

Forest products trade has increasingly been subject to requirements related to meeting environmental and social standards under several certification schemes, including chain of custody arrangements and third party audited certification. These measures are also aiming to provide assurances on the legality of timber management, harvest and associated trade.

Regional bilateral and plurilateral agreements

New Zealand is party to a number of regional bilateral and plurilateral agreements, and is negotiating further agreements. In general, these promote trade liberalisation and economic development. Agreements include those outlined below.

Asia–Pacific Economic Cooperation (APEC)

APEC, of which New Zealand is a foundation member, is a co-operative agreement that promotes trade liberalisation, facilitation and economic development. Fourteen of New Zealand's top 20 export markets are APEC members. For the 2013 calendar year, the value of New Zealand's total merchandise trade with APEC members was NZ$68.5 billion, representing 73 percent of New Zealand's total two-way goods trade (Statistics New Zealand, 2014).

APEC leaders agreed in 2010 to enhance co-operation to address concerns with illegal logging and associated trade. In 2011, APEC Ministers Responsible for Trade instructed officials to establish an Experts Group on Illegal Logging and Associated Trade (EGILAT) to:

- promote trade in legally harvested forest products;
- combat illegal logging and associated trade; and
- build capacity.

ASEAN, Australia and New Zealand Free Trade Agreement (AANZFTA)

AANZFTA was signed by New Zealand, Australian and ASEAN Trade Ministers in February 2009. The Agreement entered into force on 1 January 2010 for Australia, Brunei, Myanmar, Malaysia, New Zealand, Singapore, the Philippines and Viet Nam. It entered into force for Thailand on 12 March 2010 and Lao People's Democratic Republic and Cambodia on 1 January and 4 January 2011 respectively. It will enter into force for Indonesia after it has notified completion of its internal ratification procedures. Tariffs on key forest products will be eliminated at various points between 2010 and 2020.

Australia–New Zealand Closer Economic Relations Trade Agreement (ANZCERTA)

Under ANZCERTA, all forestry trade between the two countries is free of tariffs. The Investment Protocol to the New Zealand–Australia Closer Economic Relations Trade Agreement was signed by New Zealand and Australia in February 2011 and entered into force on 1 March 2013. The Protocol maintains the status of closer economic relations as the highest quality free trade agreement that New Zealand or Australia has with any trading partner, widely recognised as the most comprehensive bilateral free trade agreement in the world.

Trans-Pacific Strategic Economic Partnership Agreement (Trans-Pacific Agreement or TPA, formerly P4)

The TPA was signed by New Zealand, Chile and Singapore on 18 July 2005, and by Brunei on 2 August 2005. A binding Environment Co-operation Agreement and a binding Labour Co-operation Memorandum of Understanding were signed concurrently. All forest products-related trade under the TPA is tariff free.

Trans-Pacific Partnership (TPP)

The TPP has developed from the expansion of the TPA and aims to create a regional free trade agreement involving 12 Asia Pacific countries: Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the United States and Viet Nam. Negotiations under the TPP include an ambition for free trade for forest products.

New Zealand and China Free Trade Agreement

The New Zealand–China Free Trade Agreement (FTA) was signed in April 2008 and entered into force on 1 October 2008. Under the FTA, the current tariff for logs, sawn timber and wood pulp is zero. These products represent 97 percent of New Zealand forest product exports to China (year ended December 2013) (Global Trade Information Services Inc, undated). The FTA binds these existing favourable conditions.

The agreement also secured immediate tariff elimination on a limited number of engineered wood products where tariffs were either 4 percent or 7.5 percent. The products include: wooden frames for painting, windows, French windows and their frames; pallets; tool and brush handles; and specific types of plywood, fibreboard and laminated panels. Paper and paperboard products with tariffs of either 5 percent or 7.5 percent, and other types of engineered wood products with tariffs of 4 percent or 7.5 percent, are excluded from tariff elimination. In total, these products account for 2.5 percent of current exports to China (year ended December 2013) (Global Trade Information Services Inc, undated).

Pacific Agreement on Closer Economic Relations (PACER)

New Zealand has ratified the PACER, which entered into force in 2002. PACER guides future trade relations in the Pacific region, and provides for the free trade agreement in goods among Pacific Island countries (the Pacific Island Countries Trade Agreement) now being implemented and later likely to be extended to services. PACER also provides for the development of a free trade agreement among the Forum Island Countries (FIC) and Australia and New Zealand, commonly referred to as PACER Plus. PACER Plus will supersede the South Pacific Regional Trade and Economic Co-operation Agreement (SPARTECA), under which Australia and New Zealand currently provide non-reciprocal duty-free access for

FICs to their markets. For most products, including all forest products, SPARTECA entails duty-free access and this will be carried over into the new PACER Plus agreement.

New Zealand–Korea Free Trade Agreement

Negotiations have been completed on the New Zealand–Korea FTA, which will be signed in 2015. The FTA will eliminate tariffs and duties on exports, and facilitate industry co-operation between the countries.

World Trade Organization (WTO)

New Zealand is committed to the WTO, by ensuring its border protection operations and technical standards and regulations are consistent with the *WTO Agreement on Sanitary and Phytosanitary Measures* and the *WTO Agreement on Technical Barriers to Trade*.

Domestic policy

New Zealand does not restrict export of wood products (including logs) sourced from plantation forests. However, under the sustainable indigenous forest management provisions of the Forests Act 1949, export of logs and woodchips, and sawn timber for most indigenous species, is prohibited. No restrictions are in place on the export of finished products manufactured from indigenous timbers. These restrictions reflect the Government's goal of ensuring that the limited supply of slow-growing and valuable indigenous timber species is directed to high-value local finished products.

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Indicator 7.3.a Clarity and security of land and resource tenure and property rights

New Zealand's property transfer system has been in place for 140 years and provides a secure, transparent system for protecting the rights of individual and multiple owners. The system is defined in legislation, and there is a well-established compensation regime for public works.

The system provides a high degree of certainty for landowners and prospective purchasers (both domestic and international). This certainty has been a significant factor in New Zealand attracting ongoing forestry investment over the past 20 years, both in the form of new planting and the acquisition of existing land and forest assets.

An important element in assessing the strength of property rights is the level of corruption within a country, as this can add to the cost of carrying out business. In international assessments, New Zealand is perceived as having a low incidence of corruption. In 2013, New Zealand and Denmark were ranked as the least corrupt countries in two international surveys.

Rationale

This indicator provides information on land, forest and resource tenure, laws and rights. Clear title identifies rights and responsibilities under the law with respect to land and resources, while due process ensures that these rights can be protected or disputed. Lack of clear ownership or due process may hinder the active engagement of stakeholders in the sustainable management of forests, or leave forests vulnerable to illegal or unsustainable use.

NEW ZEALAND'S REPORT

New Zealand's legal and administrative systems for the protection of private property rest on the "English-law traditions of strict protection of property rights in land and interests in land" (Boast and Quigley, 2011, p 131). These systems have been progressively developed since the mid-18th century and successive governments have worked to provide landowners with certainty of tenure and legal redress in the event of contractual arrangements not being met. The current system is seen internationally as providing:

- a secure system of property rights;
- a fair and efficient judicial redress; and
- an efficient administrative system (with a low incidence of corruption) (Ministry of Agriculture and Forestry, 2009).

A stable and secure system of property rights (for both physical and intellectual property) encourages long-term investment, and borrowing for intensification or expansion. This has been seen across New Zealand's primary industries, where investment in management systems, genetics and human capital has produced ongoing gains in production and productivity. This certainty of investment has been a major factor in New Zealand's primary producers remaining competitive on the international stage and building their market presence in new and emerging products. In each case, owners had the assurance that they could loan against their property rights to improve production or enter into agreements to lease or manage properties.

New Zealand's reputation for secure property rights has been a crucial element in attracting overseas investors and skilled labour. Both of these resources are scarce internationally, and they are becoming increasingly mobile. Investors look for certainty of property rights and an ability for arbitration and redress, when investigating opportunities outside of their home jurisdiction. These legal rights can sway the balance when companies examine countries with similar resource attributes. This point has been expressed by a number of overseas investors who purchased forestry rights or land in New Zealand during the 1990s and early part of this century.

Registering private property rights

Land registration in New Zealand is based upon the Torrens system, which records transfers (and other dealings involving the land) and provides a secure form of title. The system was introduced in

New Zealand through the Land Transfer Act 1870.

> The system amounts essentially to a state guarantee of title to holders of estates in land as defined by surveys... (Boast and Quigley, 2011, p 131)

The system provides for guaranteed certificates of title, along with a low cost and efficient method of conveyancing.

The basis of the system has remained consistent over the past 140 years.

> The few amendments which have emerged over the years have generally been of an amelioratory nature and have only changed the mechanics of the Act in accordance with modern practices without departing from its basic principles. (McLintock, 2009)

In recent years, the system has evolved to include the electronic lodgement and registration of documents.

The current legislation governing land registration is the Land Transfer Act 1952 and the Land Transfer Regulations 2002. These statutory instruments are administered by Land Information New Zealand (LINZ), a government department. LINZ has oversight of the system and checks that all documents meet the legal requirements (including cadastral survey standards).

The Registrar-General of Land, based within LINZ, develops standards and sets an assurance programme for the land registration system (Land Information New Zealand, undated(b)).

Compensation for public works

New Zealand has "a strong and well-developed law of compensation for public works" (Boast and Quigley, 2011, p 129). Land required for public works can only be acquired in accordance with the Public Works Act 1981, and:

> ...provides for the payment of compensation for losses arising from the acquisition of the land by the Crown. Entitlement to compensation is set out in Part V of the Act. Section 60(1) provides that affected landowners are entitled to 'full compensation' so that they are left in a no better or worse position, than they were before the public work commenced. (Land Information New Zealand, undated(a))

Redress for property and contractual disputes

Disputes over property rights and contractual arrangements are addressed through negotiation, mediation and the courts system.

Civil disputes on property matters are frequently worked through by direct negotiation or mediation between the parties.

> The courts encourage resolution of disputes by the parties, and it is a requirement of many civil proceedings in the District Court that the parties first attend a judicial settlement conference before a trial is allocated. (Chapman Tripp, 2013, p 44).

A negotiated resolution can occur at any time during a case, but this most regularly takes place before formal proceedings.

> Civil disputes may also be resolved by private arbitration, pursuant to the Arbitration Act 1996... Some contracts provide for arbitration in the event of a dispute, but parties may also agree to arbitrate after a dispute has arisen. (Chapman Tripp, 2013, p 44).

The New Zealand courts system has evolved over the past 170 years, and includes a system of general courts and specialist tribunals. A Disputes Tribunal handles minor contractual claims (less than $15 000, or $20 000 if all parties agree), while claims of less than $200 000 are normally handled by the District Courts. Complex claims of over $200 000 are managed by the High Court. There is generally one right of appeal, from the District Court to High Court, or the High Court to the Court of Appeal. "Second appeals require the leave of either the court appealed from or the court appealed to. All appeals to the Supreme Court require the leave of that Court" (Chapman Tripp, 2013, p 42).

Special tribunals include the Environment Court, which has civil and criminal jurisdiction over environmental matters covered by the Resource Management Act 1991. "Appeals against Environment Court decisions on questions of law can be taken on to the High Court and the Court of Appeal" (Ministry for Primary Industries and the New Zealand Forestry Industry, 2013, p 10).

Business environment

> Internationally, New Zealand is viewed as one of the world's least corrupt countries to operate in ... [and] ... a number of forestry companies have stated this as a key factor in investing in New Zealand. (Ministry of Agriculture and Forestry, 2009, p 67)

For a new business or investor, a low incidence of corruption provides greater operating certainty and an assurance of secure property and intellectual rights. Corruption adds to the bottom-line cost of undertaking business in a country, from informal payments through to additional inspections and the expectation of free goods and services.

International assessments of corruption by Transparency International and World Audit both found a low incidence (or perceived incidence) of corruption in New Zealand. In their 2013 assessments, both organisations ranked New Zealand and Denmark as the least corrupt countries in which to operate. New Zealand's low incidence of corruption stems from several inter-related factors, including no history of informal payments, an independent judicial system, freedom of the press and a strong commitment to the rule of law.

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Indicator 7.3.b Enforcement of laws related to forests

Compliance with forest-related legislation is encouraged through education in the first instance. Abatement notices and enforcement orders can be used under the Resource Management Act 1991. Where offending occurs, the laws are rigorously enforced through prosecutions. Financial penalties are provided for under relevant legislation, including the Forests Act, as is imprisonment for some offences under the Conservation Act 1987, Biosecurity Act 1993 and Resource Management Act 1991.

Enforcement of forest laws continues to be a high priority for government agencies.

Quality of information: H

Progress against indicator: ▶

Rationale

This indicator provides information on the extent to which forest- related laws and regulations are enforced. The ability to successfully prosecute offenders is essential in combating harmful activities that may threaten forests and their sustainable management (e.g. illegal forest conversion and illegal logging).

NEW ZEALAND'S REPORT

Laws and regulations are enforced both by central and local government agencies.

Department of Conservation

Voluntary compliance is the aim of the Department of Conservation (DOC), but it also recognises that awareness of offences and penalties can act as a useful deterrent to offending. Compliance is encouraged by effective education and making information readily available. DOC has the options of legal compliance and enforcement to protect and preserve conservation values. These powers are derived under the legislation it administers.

The compliance and law enforcement system is based on complete integration, and the powers exercised across the various Acts are similar. The estate administered by DOC's compliance and law enforcement-warranted officers relevant to Indicator 7.3.b consists of:

- reserves (including wildlife protected areas) in a marine or terrestrial setting;
- national parks (some, such as Fiordland and Abel Tasman, are both in a marine and a terrestrial context);
- conservation areas.

DOC generally undertakes its own enforcement work because:

- the operations frequently occur in remote locations where it is not practical to call in the police;
- specialist knowledge and skills are often needed for conservation enforcement work, in terms of understanding both the legislation and the assets and values it manages;
- staff often need to act quickly to apprehend an offender or prevent the offence from causing major environmental effects.

Currently, DOC uses legal powers of warranted officers to:

- intervene to stop offending (and prevent further damage);
- investigate or apprehend people believed to have committed an offence;
- stop transportation devices;
- enter vehicles, ships or aircraft used in breach of the Conservation Act 1987, or believed to be so used;
- search land, huts, tents, caravans, other buildings (not permanent residences) and transportation devices;
- seize products illegally taken and things being used, or intended to be used, in breach of the Conservation Act 1987.

Warranted officers can deal with an offence they see occurring or they can investigate and collect evidence about an offence that they believe, on reasonable grounds, has been committed.

DOC has divided law enforcement into three facets. High-level officers are available to operate in a national context to deliver the chain of evidence

required for serious offending, such as the taking of plants (indigenous forest) or biosecurity threats. These officers carry out planned operations in areas of high risk for DOC, or where information is received that an illegal activity is taking place.

The second level is a specific role for field staff dealing with incidents in their own locations, and submitting prosecution files.

The last level involves all staff employed by DOC: they have a role to be the eyes and ears for any offending, and to pass on information to the second level for investigation.

DOC has a written Prosecution Policy (Department of Conservation, 2013).

Honorary ranger system

DOC has functions New Zealand-wide. It is impossible to carry out its statutory role without the involvement of the community, given the scale involved. For example, in the whitebait fisheries surrounded by forests in the remote parts of New Zealand, the honorary warranted officer carries out DOC's role. Expense and time-wise, it would be impossible for full-time DOC staff with compliance roles to spend the entire season in the location. The honorary system also helps DOC with capacity to carry out its statutory function. A regular reporting obligation forms part of holding the honorary warrant.

Honorary warranted officers work in three ways:

- in teams with DOC staff in surveillance roles on planned operations;
- through advocacy and education, including publicising and promoting material relating to conservation;
- in surveillance outside normal work hours.

All honorary warranted officers undertake the same five-day compliance and law enforcement course as DOC staff. Regular refresher courses are made available, as are opportunities to be part of the yearly whole-of government cross-agency training.

Ministry for Primary Industries

The Ministry for Primary Industries enforces the Forests Act 1949 and parts of the Biosecurity Act 1993. Enforcement includes bringing prosecutions against those who contravene the Acts and their regulations.

Forests Act 1949

Part 3A of the Forests Act applies to most of the privately owned indigenous forests. The number of prosecutions under this Act (generally brought for illegal harvesting of indigenous timber) has been low in recent years. This reflects an efficient control system of sawmill registration, improved understanding by forest owners of the provisions of the Act and ongoing monitoring by the Ministry for Primary Industries (MPI). In isolated areas, however, smaller scale offences can be difficult to detect.

In 2011, MPI prosecuted the largest over-harvest of indigenous timber since the sustainable forest management provisions were enacted in 1993. The defendant harvested 588 cubic metres, while the permitted volume was 373 cubic metres. Fines totalling $134 000 were imposed and the timber was forfeited to the Crown.

Biosecurity Act 1993

MPI has a specialist enforcement team with powers of prosecution for breaches of the Biosecurity Act 1993. Penalties for offences against the provisions of the Act vary according to the nature of the offence. For an individual person, penalties range up to imprisonment for a term not exceeding five years, a fine not exceeding $100 000, or both. In the case of a corporation, the penalties involve fines of up to $200 000.

New Zealand is relatively free of major pests and diseases owing to its geographic isolation, and effective biosecurity processes from pre- to post-border are important. Incoming passengers and freight are checked for the presence of items that could be carrying dangerous pests and diseases. The maximum penalty for knowingly making a false declaration about possessing such items is a fine of up to $100 000, or imprisonment for up to five years. An instant fine of $400 is levied on anyone who completes a declaration card incorrectly or forgets to declare items.

Local government

Local government (regional, district and city councils) primarily implements the Resource Management Act 1991 (RMA) (see Indicator 7.1.a).

Under section 314 of the RMA, enforcement orders can be sought by a council or any person from the Environment Court that:

> …require a person to cease, or prohibit a person

from commencing, anything done or to be done by, or on behalf of, that person that:

– contravenes or is likely to contravene the Act, any regulations, a rule in a plan, a resource consent, or certain other provisions;

– is, or is likely to be, noxious, dangerous, offensive, or objectionable to an extent that it has or is likely to have an adverse effect on the environment.

Enforcement orders can also require a person to do something that is considered necessary to ensure compliance with the Act, any regulations, a rule in a plan, a resource consent and certain other provisions, and to avoid, remedy or mitigate adverse effects on the environment caused by, or on behalf of, that person.

An authorised enforcement officer can serve an abatement notice under the RMA on any person for a similar range of circumstances as outlined above. An abatement notice is a warning to the recipient that (s)he is contravening, or is likely to contravene, the provisions of the RMA.

Penalties for offences vary, depending on their nature. For any person they extend to imprisonment for up to two years or a fine not exceeding $300 000, and where the offence is a continuing one, a fine not exceeding $10 000 for every day that the offence continues.

Regional pest management strategies for plant and animal pests are drawn up and administered by local government under the Biosecurity Act 1993. If a land occupier fails to comply with any rule in a strategy, the relevant regional council may require the landowner to undertake specified actions to address the situation. Failure to comply with a legal direction can result in the regional council entering onto the land to carry out the work itself, and subsequently recovering actual and reasonable costs from the landowner.

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Indicator 7.4.a Programmes, services and other resources supporting the sustainable management of forests

New Zealand has well developed road, rail, port and energy infrastructure networks to support the forest industry. A National Infrastructure Plan, published in 2011, and the 2012–15 National Land Transport Programme provide strategies for continuing development of these services.

Financial services are provided by a range of organisations and are regulated by the Financial Markets Authority and the Reserve Bank of New Zealand. The New Zealand Qualifications Authority ensures qualifications are robust.

Safety in forestry, particularly associated with harvesting, has become a prominent issue with a major review being undertaken in 2014 by WorkSafe New Zealand.

Rationale

This indicator provides information on the capacity of both government and private organisations to deliver programmes and services to maintain and develop infrastructure and to access the financial and human resources necessary to support the sustainable management of forests.

NEW ZEALAND'S REPORT

A range of programmes and services exist that support infrastructure, financial and human resources.

Infrastructure

New Zealand has physical infrastructure networks to support a broad range of activities, including the forest industry. Trucks transport 92 percent of New Zealand's total freight by weight, with 6 percent going by rail and 2 percent by coastal shipping. There are 91 000 kilometres of roads, 4000 kilometres of rail track, a number of sea ports (including 13 that import or export forest products), 28 regional and seven international airports. In the energy sector, most electricity is from renewable sources, including hydro, geothermal, wind and wood residues. The importance and capacity of the telecommunications sector continue to grow (New Zealand Government, 2011a).

In general, the transport infrastructure is well developed and able to meet current demands. There are some issues and specific localities where economic and population growth place pressure on aspects of the infrastructure.

The Government published the *National Infrastructure Plan 2011* to ensure that New Zealand has the infrastructure to support economic growth aspirations (New Zealand Government, 2011b). The Plan has a 20-year vision and a programme of work led by the National Infrastructure Unit (based within The Treasury). The Unit releases an annual *National State of Infrastructure Report* outlining progress in implementing the Plan and looking at the opportunities and challenges that lie ahead

Road infrastructure

Central and local government fund and operate the public road network, which is the largest capital investment in New Zealand's transport system.

The 2012–15 National Land Transport Programme is a planning and investment partnership between the New Zealand Transport Agency and local authorities, giving effect to the Government's transport priorities. The Programme involves $12.28 billion of investment in the country's land transport system over the three-year period (New Zealand Transport Agency, 2012).

New Zealand has an extensive roading network, with a total length of 90 783 kilometres of formed road. Major roads, known as state highways, and local authority roads (the secondary network) each account for about 18 billion vehicle kilometres per year.

It has been estimated that the movement of forestry goods within New Zealand totalled 37.3 million tonnes of logs and timber products in 2012. When average transport distances are taken into account, the movement of logs and wood products in New Zealand

accounted for 4.6 billion tonne-kilometres. This is 18 percent of total road tonne-kilometres, and well ahead of other commodity groups. Milk and dairy products accounted for 2.5 billion tonne-kilometres in the same year (Ministry of Transport, 2014). The capacity of some local authorities to meet requirements from increases in harvested wood volumes will present a challenge in the future.

In 2010, the Government allowed heavier (greater than 44 tonnes gross mass) and longer (exceeding 20 or 22 metres) vehicles to operate over selected routes subject to specified conditions. Trials indicated that productivity could increase by 10 percent to 20 percent, trip numbers could reduce by 16 percent and fuel use by 20 percent. This is an important initiative for the transportation of logs, but infrastructure issues, particularly bridge strength, have limited route availability for the use of these high productivity motor vehicles (Road Transport Forum New Zealand, 2010).

Another initiative, 50MAX, is a new generation of 50-tonne vehicles that have one more axle (nine) than conventional 44-tonne vehicles, spreading the load and resulting in no additional wear on roads per tonne of freight.

Rail infrastructure

Railway infrastructure in New Zealand includes about 4000 kilometres of narrow-gauge track. While rail only transports a small proportion of New Zealand's freight (6 percent by weight and 15 percent by tonne per kilometres), the freight load is predicted to double by 2040 (New Zealand Government, 2011b).

Logs, pulp, sawn timber and panel products are carried by rail to domestic destinations and export ports. Most pulp and paper is hauled by rail, but trucks dominate the market for hauling logs, lumber and wood chips. The limited transport distances and double-handling requirements constrain the use of rail in many regions.

The Government purchased the assets of the national rail operator in 2008, with the national rail system now operated by KiwiRail (a state-owned enterprise). The Government's main rail focus is the KiwiRail Turnaround Plan, which seeks to make KiwiRail a financially sustainable rail freight business.

The Turnaround Plan requires $4.6 billion of investment over 10 years, most of which will come from KiwiRail's cash flows. The Government has committed in principle $750 million for three years (New Zealand Government, 2011b).

Sea port infrastructure

Sea ports move 99 percent by volume of New Zealand's total exports. There are 13 commercial ports with significant volumes of forestry exports or imports. They are owned or majority owned by local government, with ownership in five ports partially privatised. Most forest product exporting ports are focusing on improving log storage and covered storage facilities for processed forest products.

In the year ended March 2014, 56 percent of New Zealand's harvested logs were exported. This is a significant increase from 30 percent recorded for the year ended March 2008, and has been driven by strong demand for logs from China. Sawn timber, panel products and pulp and paper are also exported (Ministry for Primary Industries, 2014).

Central government's focus is on improving public information on maritime and freight transport to support more informed decision-making. Initial work includes the Freight Information Gathering System, which will provide better information on international and domestic freight flows through New Zealand ports. The Government is also focusing on how port productivity can be improved.

Maritime New Zealand is the Crown entity with responsibilities for standards development, seafarer qualifications and licensing, oil spill prevention and response, search and rescue, inspection of ships, port and ship security, vessel safety, accident investigation and aids to navigation.

Energy infrastructure

New Zealand has over 200 power stations generating electricity, 18 natural gas fields, 18 oil fields and one oil refinery processing imported crude oil.

The New Zealand Energy Strategy 2011–2021 sets the strategic direction for the energy sector and the role energy will play in the New Zealand economy. It sets out four priority areas:

- diverse resource development;
- environmental responsibility;
- efficient use of energy;
- secure and affordable energy (Ministry of Economic Development, 2011).

The National Infrastructure Plan 2011 focuses on the infrastructure required to extract, store and distribute energy (New Zealand Government, 2011b).

In 2013 and 2014, the Government partially privatised three of the five major electricity generating companies. (The two others are privately owned.)

New Zealand's Total Primary Energy Supply (TPES) for use in the country has increased by an average of 1.9 percent per year since 2008. Oil accounts for 33 percent of the TPES, gas 21 percent and geothermal energy 19 percent (Ministry of Business, Innovation & Employment, 2013).

Renewable energy made up 37 percent of the TPES in 2012, the third-highest contribution in Organisation for Economic Co-operation and Development countries. This results from the high levels of hydro and geothermal energy used for electricity generation. Woody biomass and geothermal are the major sources of direct-use heat, with the forest industry being the major user of woody biomass.

New Zealand generated 164 petajoules (PJs) of electricity in 2012 with 73 percent coming from renewable sources. A flat demand outlook means major new investment in electricity generation is not expected before 2020.

Financial services

Financial (or economic) services are provided by a broad range of organisations, including banks, credit card companies, finance companies, credit unions, insurance companies, accountancy companies, stock brokerages and investment funds.

Financial markets are regulated by the:

- Financial Markets Authority which enforces securities, financial reporting and company law as they apply to financial services and securities markets, and regulates securities exchanges, financial advisers and brokers, trustees and issuers;
- Reserve Bank of New Zealand which holds prudential powers over the banking sector, including finance companies and credit unions.

The Serious Fraud Office is responsible for complex or serious fraud investigation and prosecutions.

The Commerce Commission is an independent Crown entity responsible for enforcing laws relating to competition, fair trading and consumer credit.

Human resources

Most forestry sector organisations recognise the importance of developing and maintaining a high level of education and skill in their workforces. Commercial forest industries face the challenge of balancing the retention of skilled staff and contractors with maintaining viability and reducing employment levels during periods of depressed demand for wood products.

Training includes formally structured, nationally recognised qualifications, in-house training programmes, and training for community-based organisations.

New Zealand Qualifications Authority

The New Zealand Qualifications Authority ensures that New Zealand qualifications are valued as credible and robust, both nationally and internationally.

The New Zealand Qualifications Framework involves 10 qualification levels that depend on the complexity of learning. The levels cover senior secondary school education, certificates, diplomas, Bachelor's degrees, postgraduate diplomas and certificates, Master's degrees and doctorates. Certificate courses cover a variety of topics relevant to the management of both the commercial plantation forest and indigenous conservation forest estates.

University programmes

The New Zealand School of Forestry at the University of Canterbury offers the only professional forestry degree programmes in New Zealand. These are:

- Bachelor of Forestry Science;
- Bachelor of Forest Engineering;
- Postgraduate Diploma in Forestry;
- Master of Forestry Science;
- Doctorate in Forestry.

Lincoln University also offers a range of forestry courses. Other universities provide undergraduate and postgraduate programmes associated with resource management, environmental sciences, sustainability and the environment, engineering and recreation, leisure and tourism.

Polytechnics

The Department of Forestry and Resource Management at the Waiariki Institute of Technology is the largest vocational forestry training centre in New Zealand. It offers qualifications in:

- forestry operations;
- forest management;
- wood manufacturing;
- occupational health and safety.

Two other polytechnics offer more restricted forestry training.

Workplace training

Competenz facilitates workplace training to build skills and add value to an organisation. It services a variety of industries and provides forest silviculture and harvesting training. (See Indicator 6.2.b.)

Health and safety

WorkSafe New Zealand is New Zealand's health and safety regulator that works with employers, employees and others to:

- educate about workplace health and safety responsibilities;
- engage in making changes that reduce the chances of harm;
- enhance workplace health and safety legislation.

The forest industry has an Approved Code of Practice for Safety and Health in Forest Operations, last updated in December 2012 by the Ministry of Business, Innovation and Employment. It is currently subject to further review.

The Health and Safety Reform Bill is currently before Parliament. When passed, it will replace the Health and Safety in Employment Act 1992.

WorkSafe New Zealand has expressed concern about safety compliance and the high rates of injury and death in the New Zealand logging industry. Ten deaths occurred during 2013. A major safety review was announced in January 2014 by the forest industry in liaison with WorkSafe New Zealand. An independent panel is examining the health and safety structure and culture of the forest industry, and reviewing health and safety education and training.

In 2014, WorkSafe New Zealand also produced best practice guidelines on safe manual tree felling. (See also Indicator 6.3.b.)

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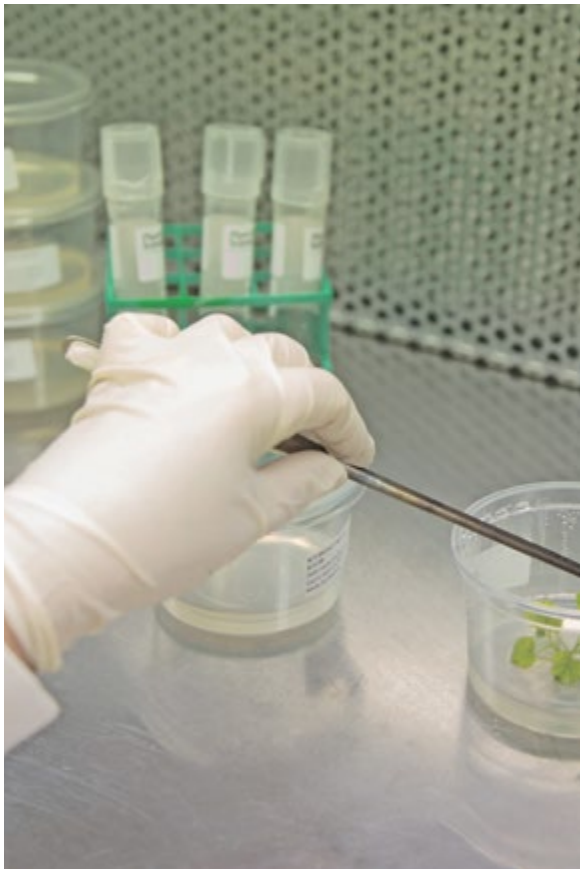

Indicator 7.4.b Development and application of research and technologies for the sustainable management of forests

New Zealand has a long history of high-quality forest research involving Crown Research Institutes and universities. Research and technologies for sustainable plantation forest management are extensive and continue to be developed. For the indigenous conservation estate, research is focused on biodiversity and management of threats from introduced pests.

New government initiatives that include forestry research are the National Science Challenges for collaborative mission-led research, the Primary Growth Partnership to encourage more private investment in research and development, and the Sustainable Farming Fund to support communities of interest to undertake research and extension projects.

Quality of information: H

Progress against indicator: ▲

Rationale

This indicator provides information on the capacity to develop and incorporate new science, research, and technologies into forest management. Continuous improvement in the depth and extent of knowledge and its application will help ensure advances in the sustainable management of forests.

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In May 2014, the Government released a *Draft National Statement of Science Investment 2014–2024*, and sought feedback on the proposed direction for, and contribution of, science investment in New Zealand. The *Draft National Statement* notes that the Government's investment in 2015/16 will be $1.5 billion, allocated through:

- collaborative mechanisms, including the National Science Challenges;
- contestable mechanisms, such as the Ministry of Business, Innovation and Employment administered sector-specific research funds;
- institutional funds, such as the Crown Research Institute core funding;
- business-led mechanisms, such as the Primary Growth Partnership (Ministry of Business, Innovation and Employment, 2014).

The 10 new National Science Challenges are mission-led programmes of work undertaken by collaborations of different researchers, organisations, end-users and business. They include:

- **Our Land and Water** – enhancing primary sector production and productivity while maintaining and improving land and water quality for future generations.
- **New Zealand's Biological Heritage** – protecting and managing biodiversity, improving biosecurity, and enhancing resilience to harmful organisms.
- **Science for Technical Innovation** – enhancing the capacity of New Zealand to use physical and engineering sciences for economic growth.

The introduction in 2014 of the forest growers levy is a notable initiative that, in part, provides funding for forest research (see Indicator 7.5.a).

Scion

Scion is a Crown Research Institute that specialises in research, science and technology development for the forestry, wood product and wood-derived materials and other biomaterial sectors. Its purpose is to drive innovation and growth from these sectors, to build economic value and contribute to beneficial environmental and social outcomes for New Zealand. In 2013/14, Scion received Crown funding of $17.7 million.

Under the Forest Science theme, Scion's work includes:

- forests and climate change – quantifying the role of forests in greenhouse gas mitigation, and evaluating the potential effects of climate change on the environment;
- forest biosecurity – focusing on the exclusion, eradication and effective management of risks to forests and trees posed by insect pests, pathogens and invasive weeds;

- rural fire research – providing specialist fire research expertise in rural and forest landscapes, developing the science and technology to protect life and property, and manage fire in the landscape;
- forest management – enabling forest growers to produce material that meets consumer needs in ways that are cost-effective, efficient and sustainable;
- tree improvement – advancing breeding programmes and deployment strategies for commercial tree species.

The Sustainable Design theme recognises the prominence of sustainability in government policy and in business. Work includes:

- measuring sustainable design – deploying models of resource use that enable environmental impacts to be measured and monitored so improvements can be made;
- optimising land value – developing new systems and approaches to integrated land management;
- environmental technologies – designing technologies that minimise ecosystem contamination through water recycling, energy reduction, environmental remediation, carbon recovery and conversion of wastes;
- trade and economic development – developing and applying economic forest sector models for forecasting and analysing the impacts of global policy on forest product markets and trade;
- social values – undertaking social science research within selected communities in areas such as sustainable biowastes management, rural fire and biosecurity management, and integrating the findings with environmental and economic research;
- human factors – recognising that the productivity of people is integral to sustainable economic success.

A six-year research programme, *Growing Confidence in Forestry's Future,* announced in 2013, is a major new initiative. The programme targets where improvements can be made throughout the growing cycle for current and future forests that will boost productivity under intensified management regimes, while maintaining wood quality and the quality of the environment. This will require a shift from the current low input forest management practices to precision forestry, integrating the latest advances in sensor technology, tree physiology, genetics and forest ecology, while working closely with the industry.

The programme is a joint initiative among Scion, the forest growing industry and the Ministry of Business, Innovation and Employment. It has been allocated funding of $3.75 million per year from the Ministry and $1.6 million per year from the Forest Growers Levy Trust.

Scion also provides research, science and technology to convert renewable wood and fibre to a range of products and energy. Core areas include:

- wood–plastic composites;
- wood drying;
- wood modification and preservation;
- timber engineering;
- pulp and paper;
- biotransformation;
- green chemical and biopolymers;
- bioplastics;
- liquid fuels;
- biorefinery pilot plants.

Landcare Research

Landcare Research is another Crown Research Institute with core Crown funding of $24.2 million in 2013/14. Its purpose is to drive innovation in the management of terrestrial biodiversity and land resources. In addition to research undertaken for the Department of Conservation (see below), other important forestry programmes focus on the following.

Sustainable indigenous forestry

The main challenge for sustainable indigenous forestry is to extract timber while maintaining or even enhancing the non-extractive benefits of these forests, such as biodiversity, water quality, carbon storage and cultural identity.

Studies of tree recruitment, growth and mortality in indigenous beech forests where low-impact harvesting has occurred have found that, with the correct management systems, the mortality rate for remaining trees does not increase. Beech trees grow very slowly in natural forest, and even-aged stands regenerating from felled forest tend to develop into dense thickets of saplings and pole-sized trees where competition between trees is strong and dominant trees are slow to emerge. The challenge for sustainable forestry is to balance the costs of thinning beech regeneration against the added value provided by the faster growth rates.

An improved understanding of indigenous forest regeneration in the Urewera Ranges of the central North Island is helping tāngata whenua (the

indigenous people of New Zealand) restore podocarp forests that were extensively logged last century.

Physiological growth modelling

How fast forests can grow and whether they will grow faster or more slowly as climatic conditions change are important questions for current and future wood supply, and for assessing the potential of forests to sequester carbon to mitigate the effects of climate change. Past assessments using empirical modelling approaches to provide growth estimates have had limited scope and reliability.

New Zealand scientists are now using a physiologically based approach to model the wood growth and carbon storage of radiata pine. The model demonstrates that pine growth is often temperature limited, with optimal growth occurring under the highest temperatures currently found in New Zealand. With climatic warming, stands are therefore likely to grow faster in the cooler parts of the South Island. In contrast, growth is likely to be reduced in the north and in the drier regions on the east coast of both islands, where warming will likely intensify water limitations. However, even these limitations could be overcome through increasing carbon dioxide levels, provided plant responses are as strong as currently seen in experimental observations.

The work has only recently been completed so has yet to be adopted by the forest industry and policymakers. The growth estimates have been used in national-scale assessments of ecosystem services and forests. The model is being used for assessing the rate of soil–carbon changes after land use change and for modelling the growth of kānuka and mānuka stands.

School of Forestry, University of Canterbury

Research is undertaken within the following four clusters:

- **sustainable land management** – better understanding the interaction among economic use, biodiversity conservation and pest management within primary production systems, in order to sustain New Zealand's unique and endemic biodiversity;
- **forest engineering** – improving the operational performance of the New Zealand forest industry (optimising economic performance while ensuring physical feasibility and social acceptability);
- **forest variability** – understanding the reduced variability in the forest resource, which increases the risks to forest growers and processors;
- **forestry as a business** – understanding the economic value of forests managed for timber, as well as other products and services.

Department of Conservation

The Department of Conservation (DOC) has administrative and management responsibility for most of New Zealand's indigenous forest area. The primary objective of that management is biodiversity conservation, but recreation also features prominently, along with cultural and historical considerations in some areas. Research and technological developments currently focus on ecological threat management. Three broad initiatives have dominated DOC's forest science, research and technological development over the past five years. They cover carbon storage in indigenous forests, improved management of threats from introduced browsing and predatory mammals, and biodiversity inventory and monitoring.

A $1.2 million five-year research programme on the impacts of introduced ungulates and possums and their management on carbon sequestration has recently been completed for DOC by Landcare Research Ltd.

A second and major focus of DOC forest research and development is aimed at management of introduced pest mammals. Rodents, particularly ship rats *(Rattus rattus),* and stoats *(Mustela erminea)* undergo periodic population irruptions in response to masting events of the southern beech species. Without management, these events are cumulatively threatening the survival of several vertebrate species. In addition to the development of new traps, toxins and delivery systems, research effort is also focused on improving wide-scale control tools such as the aerial application of toxins targeting these animals as well as brushtailed possums *(Trichosurus vulpecula)*. Besides being predators, possums are also vectors of bovine tuberculosis, as well as major defoliators and agents of stand-level dieback and canopy collapse of many indigenous tree species. Possum control with minimised non-target effects is therefore an important research and development goal.

The national Biodiversity Monitoring and Reporting System has been developed by DOC and Landcare Research Ltd over the past seven years (2007–14). The objective is a consistent approach to monitoring and reporting on the state of, and trends in, ecological integrity in terrestrial, freshwater and marine

environments, but its major application to date has been to forest and non-forest lands. The whole system is designed around three "tiers", which operate at different scales with varying levels of detail and coverage.

Tier 1 monitoring samples all public conservation land, and potentially the whole of New Zealand, through regular assessment of a selection of native species and pests (including game animals) at 2500 locations (1405 are on public conservation land) 8 kilometres apart and spaced evenly across the landscape. It provides both unbiased, repeatable indicators of ecological integrity across all public conservation land and waters managed by DOC, and other national-level information collected through desktop exercises and other targeted field-based programmes.

Tier 2 monitoring involves consistent, rigorous monitoring of results and outcomes for ecosystems and species that are managed. Tier 3 monitoring involves intensive research and biodiversity measurement at a few important sites distributed throughout New Zealand. (See indicators 1.2.a and 7.5.c for further information.)

Ministry for Primary Industries

The Ministry for Primary Industries administers two programmes that offer funding for research related to the primary sectors.

The goal of the Primary Growth Partnership (PGP) is to encourage more private investment in existing and new research and development in New Zealand, which is low by Organisation for Economic Co-operation and Development standards. PGP programmes are primarily business-led and market driven innovation programmes that are jointly funded by government and industry. They focus on boosting productivity and profitability, and delivering long-term economic growth and sustainability across the primary sectors.

Of the 18 announced PGP programmes, three involve the forestry sector and total $79 million (from government and industry). They concern:

- steepland harvesting – with the focus on development of a steep-slope, feller-buncher;
- methyl bromide reduction – the aim is to reduce its use for quarantine and pre-shipment fumigation of exported forest (and horticultural) products, and eventually replace it with alternative treatments;
- forest waste to liquid fuels – investigating how to generate more value from forestry waste by converting it to liquid biofuels.

The Sustainable Farming Fund (SFF) supports "communities of interest" to undertake research and extension projects that tackle a shared problem or develop a new opportunity in the primary sectors. Most projects leverage a high proportion of other funding or in-kind support to complement the SFF grant.

Between 2010 and 2014, there were 30 forestry-related projects with SFF funding.

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Robot being developed for felling plantation forest.

Indicator 7.5.a Partnerships to promote the sustainable management of forests

Partnerships are becoming increasingly important in the management of the conservation estate. The Department of Conservation has formed a new Conservation Partnerships Group to work with a range of businesses and community groups.

For the commercial plantation forest sector, partnerships focus on research. The Forest Growers Levy Trust is a new enterprise administering a plantation forest growers' levy for a variety of industry-good initiatives.

Rationale

This indicator provides information on partnerships and their contribution to the sustainable management of forests. Partnerships may help create a shared purpose and are important tools in building capacity; leveraging financial, technical and human resources; strengthening political commitment; and in developing public support to advance the sustainable management of forests.

NEW ZEALAND'S REPORT

Partnerships are becoming increasingly important in the management of the indigenous conservation forest estate. For commercial plantation forests, the significance of partnerships lies mainly in research.

Indigenous forests

Department of Conservation

To progress priorities in conservation management, the Department of Conservation (DOC) is increasing business partnerships and community involvement through community-led projects.

To facilitate this work, a new Conservation Partnerships Group has been established within DOC. The group has partnership staff working in close to 100 offices across the country. Their work involves creating awareness and interest in conservation and exploring new conservation projects and initiatives in partnership with others. Three specialist teams focus on commercial business, community engagement and integration.

DOC relies on partnerships with the community to achieve its objectives in conservation management. These partnerships include:

- a Treaty of Waitangi partnership with Māori;
- working with regional and district councils to implement their responsibilities for biodiversity conservation in regional and district plans and coastal plans under the Resource Management Act 1991;
- working with environmental non-government organisations, trusts and other community interest groups;
- working with private landowners for the protection of natural areas through covenants and other conservation measures such as Ngā Whenua Rāhui;[56]
- working with universities and research institutions to improve knowledge and techniques of conservation;
- working with education providers to enable them to deliver conservation education programmes;
- providing and promoting opportunities for community involvement in practical conservation projects and policy development;
- joint programmes for the protection of biodiversity, such as Project Crimson, and organisations such as the Nature Heritage Fund.

Notable existing business partnerships with DOC related to the indigenous conservation forest estate involve:

- **Air New Zealand** – to promote and protect the Great Walks and preserve threatened species;
- **Dulux New Zealand** – to paint and protect

56 A contestable fund with which to negotiate the voluntary protection of indigenous forest on Māori-owned land.

backcountry huts and other recreation and historic assets, and to support the Kea Conservation Trust;
- **Genesis Energy Whio Recovery Programme** – to support the whio/blue duck recovery;
- **Kākāpō Recovery Partnership** – to support kākāpō recovery;
- **Mitre 10 Takahē Rescue** – to support the Takahē Recovery Programme;
- **Project Crimson Trust** – to plant and protect pohutukawa and rata trees throughout the country;
- **the Kiwi Trust (BNZ)** – to support kiwi conservation groups across the country.

In March 2014, the Minister of Conservation announced a Community Conservation Partnerships Fund to support the work of voluntary organisations undertaking natural heritage and recreation projects. The new fund of $26 million over four years is distributed to community organisations in annual contestable funding rounds of between $6 million and $7 million a year. It replaces the previous Biodiversity Advice Fund and Biodiversity Condition Fund of $3.6 million per year.

The Community Conservation Partnerships Fund is directed at:
- practical, on-the-ground projects that:
- maintain and restore natural heritage diversity;
- enable more people to participate and enjoy recreation in the natural environment;
- encourage more people to be involved with, and value, the benefits of conservation;
- projects that have a transformational impact on conservation growth in New Zealand.

Queen Elizabeth II National Trust, Royal Forest and Bird Protection Society of New Zealand and other organisations

The Queen Elizabeth II National Trust works with private landowners in New Zealand to protect special natural and cultural features on their land with open-space covenants. As at June 2014, there were 3934 registered covenants and 414 approved covenants, covering a land area of 180 845 hectares.

The Royal Forest and Bird Protection Society works in partnership with other environmental organisations, government agencies, businesses and community groups to achieve conservation objectives. In addition to involvement in the Kākāpō Recovery Partnership, Genesis Energy Whio Recovery Programme and the Kiwi Trust (see above), other major collaborative projects relating to indigenous forests that the Royal Forest and Bird Protection Society is involved with include:
- **High country parks** – advocating for high country parks to protect landscapes, native plants and animals;
- **Ark in the Park** – to restore the wilderness and wildlife of the Waitakere Ranges;
- **BirdLife International Community Conservation Fund** – sponsoring community projects to conserve threatened species;
- **JS Watson Conservation Trust** – sponsoring community conservation projects.

Local government is also involved with a range of forest-related partnership programmes in parts of the country.

Plantation forests

Research

It is common for Crown Research Institutes and universities to work in partnerships with other institutes and/or universities to research forestry and forestry-related topics.

Other forestry research partnerships include:
- the Radiata Pine Breeding Company – comprises 19 New Zealand and Australian forestry companies, consultants, seed and seedling suppliers, and focuses on tree improvement research;
- Solid Wood Innovation – a consortium of about 26 companies working on the increased and more efficient manufacturing of appearance-related wood products, energy efficiency and reduced water use in wood drying.

Forest Growers Levy Trust

The Forest Growers Levy Trust is an incorporated society with board members representing large-scale plantation forest owners (members with at least 1000 hectares of forest) and small-scale plantation forest owners (members with less than 1000 hectares of forest).

The Trust is responsible for the administration of a plantation forest growers levy that came into force in January 2014. The levy is imposed on logs harvested from plantation forests in New Zealand, and forest owners are primarily responsible for the payment. The initial rate of the levy (for the year ending 31 December 2014) was set by the Trust at 27 cents per tonne of harvested wood. (See Indicator 6.2.b for further information and an explanation of how the levy is spent.)

National Exotic Forest Description

The National Exotic Forest Description (NEFD) provides publicly available area-age class data by species or species groups by local authority for New Zealand's commercial plantation forests.[57]

The NEFD has been managed as a partnership between the New Zealand Forest Owners Association and the Ministry for Primary Industries (MPI) for nearly 30 years through a steering committee with representation from the two partners. The forest owners provide the forest resource information, and MPI undertakes the data collection, collation and dissemination.

Ministry for Primary Industries

MPI's mission is growing and protecting New Zealand. An important part of the approach to achieving this involves partnering with primary industries.

The Sector Partnerships and Programmes (SPP) Branch delivers MPI's non-regulatory programmes and initiatives to promote sustainable economic growth, such as Primary Growth Partnerships, the Sustainable Farming Fund and the Māori Agribusiness programme. SPP has an important role in linking government with industry and provides an entry point for stakeholders seeking access to growth-related initiatives.

The two contestable research funding programmes, the Primary Growth Partnership and Sustainable Farming Fund, enable MPI to partner research initiatives of agencies and community groups through partial funding. These programmes have been discussed under Indicator 7.4.b.

Biosecurity

Better Border Biosecurity (B3) is a multi-partner, co-operative science collaboration that researches ways to reduce the entry and establishment of new plant pests and diseases in New Zealand.

B3 is the science vehicle underpinning New Zealand's current practice, and for anticipating and informing future challenges and opportunities, for plant-based border security. It provides science-based solutions for supporting and protecting the international competitiveness of the country's export industries and protecting territorial ecosystems.

The B3 unincorporated joint venture integrates investment and expertise from five science agencies (Plant and Food Research, AgResearch, Scion, Landcare Research and the Bio-Protection Research Centre) and three end-user partners (MPI, DOC and the New Zealand Forest Owners Association).

57 See **http://www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/forestry/.**

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Indicator 7.5.b Public participation and conflict resolution in forest-related decision making

Good information to support public participation in forest-related decision making is available for the commercial plantation sector and the conservation estate. A range of legislatively based and semi-formal mechanisms provide for public input to decision-making processes on resource management. Dispute resolution processes exist in some situations.

Forest certification has increased opportunities for community consultation in commercial forestry.

Quality of information: M

Progress against indicator: ▲

Rationale

This indicator provides information on the processes that promote public participation in forest-related decision making and reduce or resolve conflict amongst forest stakeholders. Public participation in decision making processes and conflict resolution efforts can lead to decisions that are widely accepted and result in better forest management.

NEW ZEALAND'S REPORT

Information

The Official Information Act 1982 makes official information more freely available to members of the public of New Zealand. This helps their effective participation in the making and administration of laws and policies. The main principle governing release of official information is that "…information shall be made available unless there is good reason for withholding it" (section 5). Section 6 of the Act identifies the reasons for which official information can be withheld.

A wide range of general information and data related to the New Zealand forestry sector is freely available through government departments, particularly the Ministry for Primary Industries, Department of Conservation (DOC), Ministry for the Environment and Statistics New Zealand. This helps informed public participation in decision-making processes.

Central government

National policy influencing forestry is developed by central government. In the policy development process, public consultation may be undertaken.

The New Zealand Parliamentary system has one legislative chamber, an elected House of Representatives. All legislative Bills[58] are referred to select committees (small groups of Members of Parliament) for consideration. Select committee consideration allows the public to examine and have input, through written and oral submissions, to draft legislation before it passes into law.

Local government

At regional and district levels, the Resource Management Act 1991 provides for Māori and members of the wider community to take part in planning the management of resources of their area. Examples are public consultation and input in the initial stages of preparing policy statements and plans, and submissions to local governments after the public has been notified about policy statements, plans or plan changes. Certain applications for resource consents for proposed activities with potentially adverse environmental effects must be publicly notified and allow for submissions.

Long-term council community plans are prepared under the Local Government Act 2002. Part of their purpose is to provide an opportunity for participation by the public in decision-making processes on activities that are to be undertaken by regional, district and city councils.

58 Except those considered under urgency, and Appropriation and Imprest Supply Bills.

Department of Conservation

Involving the community in caring for its heritage through education, sponsorships, awards, community involvement programmes, partnerships and events such as Conservation Week is an important part of DOC's work. Public involvement activities range from national-level initiatives to locally run community programmes.

DOC provides a range of levels of engagement for the public. Its visitor information centres provide interpretation of New Zealand's indigenous ecosystems. There are volunteer programmes and annual events such as Arbor Day. Information about New Zealand's biodiversity is also made available through mechanisms such as educational resources for schools, fact sheets, scientific papers, public discussion documents, maps and media articles. DOC's website provides access to these resources.[59] In addition, DOC supports community-initiated conservation projects, either on conservation land administered by DOC or on other land with significant conservation value.

59 See **http://www.doc.govt.nz**.

Ministry for Primary Industries

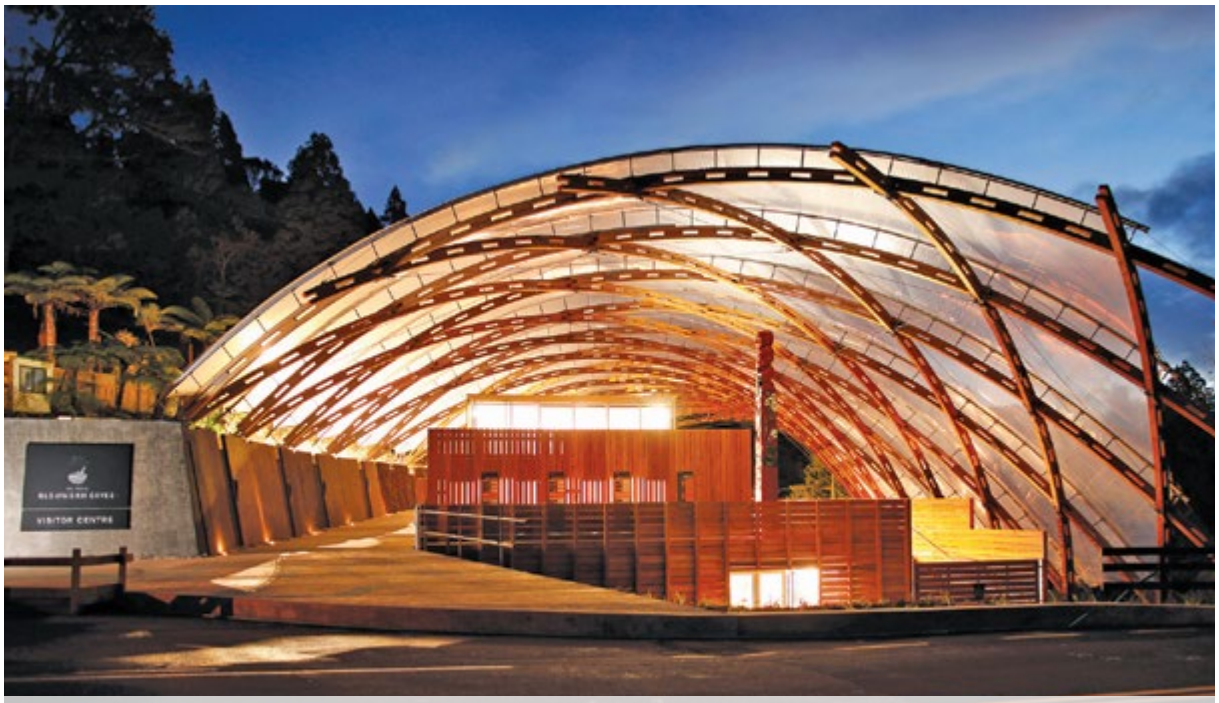
The Ministry for Primary Industries has a specific focus on the collection, collation and dissemination of information and statistical data concerning commercial plantation forests, the primary processing of wood products, and international and domestic trade of wood products. These cover quarterly and annual releases of statistics on logs and roundwood removals and on the production of sawn timber, panel products, pulp, paper and paperboard, and wood chips. The exports and imports of forest products are covered by annual releases of statistics. The information is available on the department's website.[60]

This information facilitates informed public participation in forestry issues and decision-making processes.

Commercial forest owners

More than 90 percent (by area) of the commercial forest estate is held in various forms of private ownership. About 61 percent of the total area (mostly held by large-scale forest owners) has certification

60 See **http://www.mpi.govt.nz/news-and-resources/statistics-and-forecasting/forestry**.



The Waitomo Glowworm Caves Visitors Centre: engineered timber was used to construct the curved roof.

under the Forest Stewardship Council (FSC) International Standard, and a national standard for FSC endorsement is in preparation. Another national standard (NZS AS 4708:2014 Sustainable Forest Management) was published by Standards New Zealand in May 2014, and will provide a further avenue for forest certification when auditors have been accredited. It is anticipated that endorsement of this standard will be sought under the Programme for the Endorsement of Forest Certification (PEFC).

The FSC International Standard, the standard in preparation for FSC endorsement, and NZS AS 4708:2014, all variously contain requirements for forest managers to engage on forest management matters with affected and interested stakeholders, with local communities and with indigenous peoples.

Other opportunities for public participation may occur when forest managers seek resource consents under regional and district council planning procedures.

Conflict resolution

Several conflict resolution processes are available to stakeholders and members of the public:

- judicial review can be sought for any decision, proposed decision or refusal to exercise a power of decision by the Executive of Parliament or a public body according to law;
- the Ombudsman handles complaints against government agencies and access to official information;
- legislation may include appeal procedures through the courts;
- the Disputes Tribunal deals with many types of disputes with a value of up to $15 000 (and, with agreement, up to $20 000);
- parties may agree to arbitration or mediation (professional arbitrators and mediators are available).

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Indicator 7.5.c Monitoring, assessment and reporting on progress towards sustainable management of forests

National environmental monitoring continues to evolve, driven by domestic and international concerns for the environment. Detailed statistical data from comprehensive inventory systems exist for commercial plantation forests, while data for indigenous forests are available at a lower level of detail. New Zealand reports internationally through the United Nations Food and Agriculture Organization's Global Forest Resource Assessment and the Montreal Process.

Recent initiatives include the Environmental Reporting Bill, the release of version 4 of the Land Cover Database (Landcare Research) and the progressive implementation by the Department of Conservation of the national Biodiversity Monitoring and Reporting System.

Quality of information: M/H

Progress against indicator: 

Rationale

This indicator provides information on the capacity to monitor, assess and report on forests. An open and transparent monitoring and reporting system that provides up-to-date and reliable forest-related information is essential for informed decision making, in generating public and political awareness of issues affecting forests and in the development of policies to underpin the sustainable management of forests.

NEW ZEALAND'S REPORT

National environmental reporting

The Ministry for the Environment (MfE) reports on the state of New Zealand's environment and provides information on the state of the air, atmosphere and climate, freshwater, land, and marine environment. MfE uses its own data and data collected from several other agencies for this reporting. These include local authorities, Crown research institutes and other government departments.

Reporting on land has been based on six national environmental indicators: land cover, land use, soil health, soil erosion risk, area of indigenous land cover and the distribution of seven selected indigenous species. These may change if the Environmental Reporting Bill, introduced into Parliament in February 2014, is passed in to law. The purpose of this Bill is to create a national-level environmental reporting system to ensure that reporting on the environment occurs on a regular basis and can be trusted by the public as independent, fair and accurate. Responsibility for environmental reporting will lie with the Secretary for the Environment and the Government Statistician: the latter to ensure reporting is at arm's length from the government of the day.

Two land classification systems are used to report on New Zealand's land, the Land Cover Database and Land Environments of New Zealand, as described below.

New Zealand Land Cover Database

The New Zealand Land Cover Database (LCDB) is a Crown-owned, digital thematic classification of land cover and land use classes. It is designed for use in geographic information systems or as printed maps.

The current version 4 of the LCDB was released in 2014 and uses 33 land cover classes. These include nine forest or shrubland categories.

Land Environments of New Zealand

Land Environments of New Zealand (LENZ) is a quantitatively based classification of the country's terrestrial environments that helps biodiversity conservation and natural resource management. It identifies climatic and landform factors likely to influence the distribution of species, and uses these to group together sites that have similar environmental conditions.

LENZ maps New Zealand's landscapes at four different levels using 20, 100, 200 or 500 environments.

Local government environmental monitoring

Local government must monitor the state of the environment for their region or district under the Resource Management Act 1991. Although reporting the results of this monitoring is not a legislative requirement, councils must make a review of the results of their monitoring available to the public at least every five years.

Forest inventories

Three national-scale forest inventories have been undertaken in New Zealand, the most recent being through the ongoing Land Use and Carbon Analysis System (LUCAS). The focus of the LUCAS forest inventories is carbon, but they also provide other metrics for different reporting purposes, for example, standing volume for the Global Forest Resources Assessment reporting. Further, the Department of Conservation's (DOC's) Biodiversity Monitoring and Reporting System is integrated into the LUCAS indigenous forest inventory. The original national forest inventory was undertaken between 1921 and 1923, and another national forest survey was conducted between 1946 and 1955.

Land Use and Carbon Analysis System

LUCAS was established in 2005 and helps New Zealand meet its international reporting requirements under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. It is a cross-government programme led by MfE.

Land use data are collected for indigenous and plantation forests, and both are sub-divided between those established before 1990 and those established after 1989.

Between 2002 and 2007, a network of about 1257 permanent 20 metre by 20 metre plots was established on an 8 kilometre grid system across indigenous forests. An 8 kilometre grid system has also been used to establish permanent plots in pre-1990 plantation forests, while a 4 kilometre grid system has been used for plots in post-1989 forests. For plantation forests, airborne scanning using Light Detection and Ranging (LiDAR) is used in a double-sampling approach to increase the precision of the estimates.

The intention is to re-measure plantation forests every five years and indigenous forests every 10 years from 2014. (See Criteria 2, 3 and 5 and State of New Zealand's Forests.)

National Exotic Forest Description

The National Exotic Forest Description (NEFD) is New Zealand's commercial plantation forest resource description. It is prepared by the Ministry for Primary Industries and the New Zealand Forest Owners Association to help with resource and policy planning.

The NEFD comprises two data sets. The first is an area-age class data set with net stocked forest area by district and/or city council administrative area, year of planting, species and management regime. The second is a yield table data set with stem volume broken down into pruned, sawn and pulp logs by location, age, species and management regime.

In addition to the area-age class and yield information, data on planting, harvesting and some ancillary forest resource data are collected. NEFD forest area reports are published each year; and yield tables are published from time to time. At about five-year intervals, national and regional wood availability forecasts are prepared from the NEFD data sets.

The 31st edition of the annual NEFD report describes the plantation forest resource as at April 2014.

Other forest-related inventories

National Vegetation Survey databank

Ecologically based vegetation monitoring has been undertaken over the past 50 years or so. The resulting information has been brought together in the National Vegetation Survey (NVS) databank, the largest vegetation database in New Zealand.

The NVS is a physical archive and electronic databank containing records from about 94 000 vegetation survey plots – including data from over 19 000 permanent plots. NVS provides a unique record, spanning more than 50 years, of indigenous and exotic plants in New Zealand's terrestrial ecosystems. Broad ranges of habitats are covered, with an emphasis on indigenous forests and grasslands.

The physical archive includes plot sheets, maps and photographs from many years of vegetation surveys. Software for entering, validating and summarising data is available.

The former New Zealand Forest Service, the Department of Lands and Survey and the Botany Division of the Department of Scientific and Industrial

Research (DSIR) conducted the original surveys. Ongoing surveys and research by MfE, DOC, regional councils, universities and Landcare Research are constantly providing new data to NVS.

Data within NVS can support reporting requirements for the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change, state of the environment reporting, the Resource Management Act 1991 and the Montreal Process. Historical information in NVS has significance in enabling New Zealand to address issues of current concern that were unforeseen at the time of data collection. Examples are: assessing the impact of climate change on indigenous ecosystems, the storage of carbon in indigenous ecosystems and setting restoration goals in areas since degraded.

Biodiversity Monitoring and Reporting System

DOC is progressively implementing a national system to monitor and report on New Zealand's biodiversity. The Biodiversity Monitoring and Reporting System provides DOC with comprehensive information about biodiversity on public conservation lands, and potentially across New Zealand.

The system uses indicators and measures from the New Zealand Biodiversity Assessment Framework (see Lee et al, 2005). It has three tiers of information that operate at different scales and have varying levels of detail and coverage:

- **Tier 1** is broad scale with monitoring on 1405 sites on the public conservation estate over five-year periods. (See Department of Conservation, Indicator 7.4.b, for a fuller description.) The two biodiversity indicators are the dominance of exotic weeds, pests and threats, and the mix of indigenous plants and animals. (Another 1100 sampling sites lie outside the conservation estate.)
- **Tier 2** focuses on detailed information needed to manage ecosystems and species effectively and involves consistent monitoring and reporting of results and outcomes achieved in terrestrial, freshwater and marine environments.
- **Tier 3** combines intensive research and monitoring at a few important sites to help predict and interpret national and local-scale trends, and provide the understanding needed to maintain or restore biodiversity.

Commercial forestry statistics

New Zealand has a rich set of commercial forestry statistics, some dating back to the 1920s. These statistics cover forest planting, harvesting, processing and trade in forestry products.

Ministry for Primary Industries

The Ministry for Primary Industries collects, collates and publishes forestry production and trade statistics on a quarterly basis. Annual production and trade tables are also published.

The statistics cover:

- **production** – roundwood removals from plantation and indigenous forests, and the production of sawn timber, panels, pulp, and paper and paperboard;
- **trade** – log, chip and sawn timber exports by port of loading and country of destination, and pulp and panel exports by country of destination;
- **stocks** – estimates of the quantities of sawn timber, panels and pulp and paper on processors' sites.

Since 2003 the NZ Forest Owners Association, in conjunction with MPI, has published an annual collection of key statistics on plantation forestry called *New Zealand Plantation Forestry Industry Facts and Figures*.

Statistics New Zealand

Statistics New Zealand is central government's statistics agency. It publishes a number of forestry-related statistics in addition to those published by the Ministry for Primary Industries. A core focus of Statistics New Zealand is the production of key economic and population statistics.

International reporting

Information and data from the processes identified above provide the basis for New Zealand's international forest reporting. The two principal reports are the Global Forest Resources Assessment for the United Nations Food and Agriculture Organization, and this report for the Montreal Process. Both reports are completed at around five-yearly intervals.

Other forestry-related reporting is provided to the United Nations Forum on Forests and the Convention on Biological Diversity.

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APPENDIX 1:
COMMON AND CORRESPONDING BOTANICAL NAMES

Acacia	*Acacia* spp.
Ash	*Fraxinus excelsior*
Black beech	*Fuscospora solandri*
Broom	*Cytisus scoparius*
Cypress	*Cupressus* spp.
Douglas-fir	*Pseudotsuga menziesii*
Elm	*Ulmus* spp.
Eucalypts	*Eucalyptus* spp.
Ginseng	*Panax ginseng* and *P. quinquefolium*
Gorse	*Ulex europaeus*
Hall's tōtara	*Podocarpus hallii*
Hard beech	*Fuscospora truncata*
Hawthorne	*Crateaegus* spp.
Hinau	*Elaeocarpus dentatus*
Kahikatea	*Dacrycarpus dacrydioides*
Kāmahi	*Weinmannia racemosa*
Kānuka (tea tree)	*Kunzea ericoides*
Karamu	*Coprosma robusta*
Kauri	*Agathis australis*
Kohekohe	*Dysoxylum spectabile*
Koromiko	*Hebe salicifolia*
Kotukutuku	*Fuchsia excorticata*
Makomako (wineberry)	*Aristotelia serrata*
Mangeao	*Litsea calicaris*
Mangrove	*Avicennia marina* var. *resinifera*
Mānuka (tea tree)	*Leptospermum scoparium*
Matagouri	*Discaria toumatou*
Matāi	*Prumnoptys taxifolia*
Miro	*Prumnoptys ferruginea*
Mountain beech	*Fuscospora cliffortioides*
Northern ratā	*Metrosideros robusta*
Oak	*Quercus* spp.
Pahautea	*Libocedrus bidwillii*
Pink pine	*Halocarpus biformis*
Podocarps	*Podocarpus* spp.
Pohutukawa	*Metrosideros excelsa*
Poplar	*Populus* sp.
Radiata pine	*Pinus radiata*
Red beech	*Fuscospora fusca*
Rewarewa	*Knightia excelsa*
Rimu	*Dacrydium cupressinum*
Silver beech	*Lophozonia menziesii*
Southern rātā	*Metrosideros umbellata*
Sphagnum moss	*Sphagnum cristatum*
Taraire	*Beilschmiedia tarairi*
Tawa	*Beilschmiedia tawa*
Tāwari	*Ixerba brexiodes*
Tea tree (kānuka)	*Kunzea ericoides*
Tea tree (mānuka)	*Leptospermum scoparium*
Tōtara	*Podocarpus totara*
Tree daisy	*Olearia gardneri*
Willow	*Salix* spp.
Wineberry (makomako)	*Aristotelia serrata*

APPENDIX 2:
ABBREVIATIONS USED AND THEIR MEANINGS

1080	Sodium monofluoroacetate
AANZFTA	ASEAN, Australia and New Zealand Free Trade Agreement
ACC	Accident Compensation Corporation
AFOLU	Agriculture, forestry and other land uses
AGS	Afforestation Grant Scheme
ANZCERTA	Australia–New Zealand Closer Economic Relations Trade Agreement
ANZSIC	Australian and New Zealand standard industrial classification
APEC	Asia–Pacific Economic Cooperation
BERL	Business and Economic Research Ltd
BMRS	Biodiversity Monitoring and Reporting System
B3	Better Border Biosecurity
C&I	Criteria and indicators
CO2	Carbon dioxide
COHFE	Centre for Human Factors and Ergonomics
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DOC	Department of Conservation
DSIR	Department of Scientific and Industrial Research
ECFP	Erosion Control Funding Programme (East Coast) (formerly the East Coast Forestry Project)
ETS	Emissions Trading Scheme
FAO	United Nations Food and Agriculture Organization
FGLT	Forest Growers Levy Trust
FIC	Forum Island Countries
FITEC	Forest Industries Training and Education Council
FSC	Forest Stewardship Council
FTA	Free trade agreement
FTE	Full-time equivalent
GDP	Gross domestic product
GFC	Global financial crisis
GHG	Greenhouse gas
GST	Goods and services tax
ha	Hectares
HWP	Harvested wood products
IPCC	Intergovernmental Panel on Climate Change
IRIS	Incident Reporting Information System
ITO	Industry training organisation
IUCN	International Union for Conservation of Nature
LAWA	Land and Water Aotearoa
LCDB	Land Cover Database (versions 2, 3 and 4)
LENZ	Land Environments of New Zealand

LiDAR	Light Detection and Ranging
LINZ	Land Information New Zealand
LRI	New Zealand Land Resource Inventory
LUCAS	Land Use and Carbon Analysis System
LULUCF	Land use, land-use change and forestry
MAF	Ministry of Agriculture and Forestry (one of the ministries that became MPI)
MBIE	Ministry of Business, Innovation and Employment
MfE	Ministry for the Environment
MPI	Ministry for Primary Industries
m^3	Cubic metres
NBMRP	National Biodiversity Monitoring and Reporting Programme
NCEA	National Certificate of Educational Achievement
NEFD	National Exotic Forest Description
NIWA	National Institute of Water and Atmospheric Research
NRFA	National Rural Fire Authority
NVS	National vegetation survey
NWFP	Non-wood forest products
NZ	New Zealand
NZeem®	New Zealand empirical erosion model
NZETS	New Zealand Emissions Trading Scheme
NZFOA	New Zealand Forest Owners Association
NZFSA	New Zealand Food Safety Authority
NZQA	New Zealand Qualifications Authority
NZU	New Zealand Unit: unit of trade for the Emissions Trading Scheme, 1 NZU = 1 tonne of CO_2-equivalent emissions
OECD	Organisation for Economic Co-operation and Development
PACER	Pacific Agreement on Closer Economic Relations
PCE	Parliamentary Commissioner for the Environment
PEFC	Programme for Endorsement of Forest Certification
PGP	Primary Growth Partnership
PJ	petajoule
PNB	Physiological needle blight
PTA	*Phytophthora* taxon Agathis
R&D	Research and development
RMA	Resource Management Act 1991
SFF	Sustainable farming fund
SFM	Sustainable forest management
SPARTECA	South Pacific Regional Trade and Economic Co-operation Agreement
SPP	Sector Partnerships and Programmes Branch, Ministry for Primary Industries
spp.	Species
Tb	Bovine tuberculosis
TIMO	Timber investment management organisation

TPA	Trans-Pacific [Strategic Economic Partnership] Agreement
TPES	Total Primary Energy Supply
TPP	Trans-Pacific Partnership
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WTO	World Trade Organization