

Land-use change

A history of fire in the forest and rural landscape in New Zealand

Part 1, pre-Maori and pre-European influences

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Introduction

New Zealand has a much longer natural history than many people realize. From its very early “escape” from Gondwanaland, about 80 million years ago, to the present day, its history has been one long series of ups and downs. The distant origins of our unique flora and fauna lie buried in the depths of Gondwanaland (Gibbs 2007 and Poole 1987). Ancient ancestors of our native southern beech, podocarp and kauri forests, also developed and diversified in many other countries which were part of the Gondwanaland massif (Figure 1). Consequently, you may

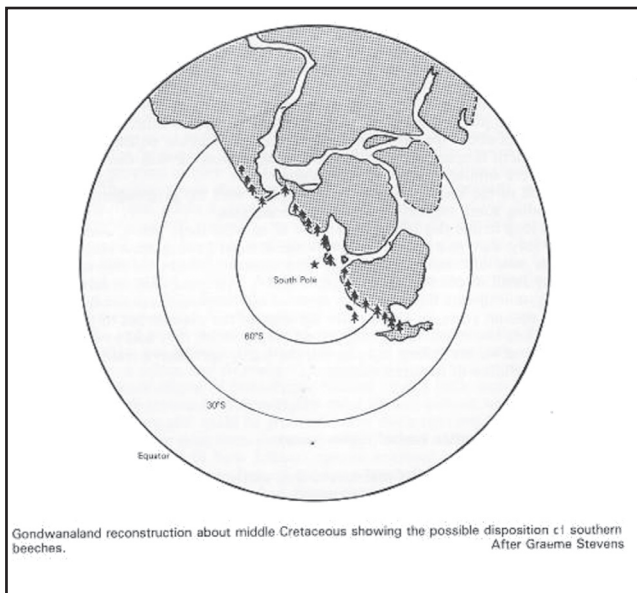


Figure 1. Gondwanaland reconstruction - figure page 18 from Poole.

find today, different species of southern beech in Australia, New Caledonia, Papua New Guinea and Chile, podocarps in South Africa and Papua New Guinea, and kauri in Queensland, the Solomon Islands, and Fiji. Believe it or not, there is even fossil evidence of kauri and southern beech in Antarctica, relics from when that land mass enjoyed a period closer to the equator. But what sets New Zealand flora and fauna apart from the rest of the world is its development in long isolation, though the lack of land bridges which play such a big part in the evolution and development of native flora and fauna in any region. (Diamond, 1997)

The arrival of humans to New Zealand, as recently

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as 800 years ago (but maybe slightly earlier), has created an artificial (and selective) land bridge. The new arrivals brought new species, pests and diseases, most of which have had a significant impact on the native flora and fauna. Add to this the indiscriminate use of fire started by mankind, and the result has been quite devastating.

Halkett (1991) describes it this way. “In less than a millennium Polynesians burnt almost one third (6.7 million hectares) of New Zealand’s 21 million hectares of native forest cover. Then, in less than a century-and-a-half, uncontrolled fires and destructive logging by European immigrants destroyed a further third (8 million hectares) of the original forest cover.

Today, less than a quarter, or about 23% of the land, remains forested” (Figure 2).

Meanwhile, mother earth continues her own inexorable life, the origins and the ends of which we can only speculate. The active movement of the Pacific Plate, which is pushing

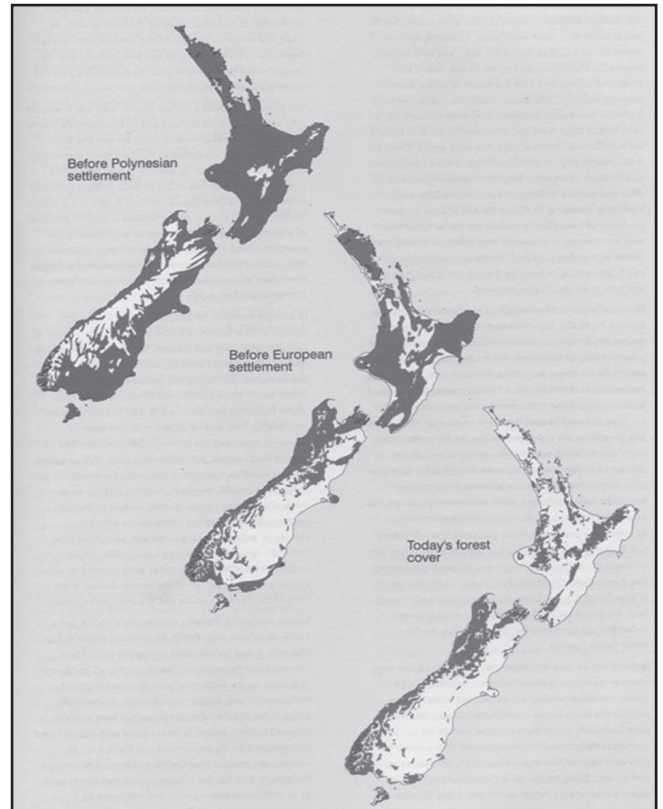


Figure 2. Human impacts on New Zealand’s natural forest and tall shrubland – figure 8.5 from State of New Zealand’s Environment, page 8.29.

under the Indo-Australian Plate, is causing significant up-thrusts, particularly along the alpine faultline, where the upward movement can be measured in terms of millimetres per annum. Soil instability in other parts of New Zealand, such as the un-consolidated sands of the Manawatu hill country, can also be partly blamed on continuing upward movement, but this has been greatly accelerated by man's interference through the clearing of native forest in the late 1800's for conversion to pasture.

We live in a country in which very active geological changes are constantly occurring, and which, after a long period of isolation, has been invaded by humans and their baggage. In enjoying the delights of New Zealand, we also have a responsibility to future generations to ensure that we are good stewards of the land and its natural heritage, and that we leave behind a legacy that will endure.

Pre-Maori

1. Natural causes of fire in New Zealand

The natural causes of fire in New Zealand were lightning and volcanoes. Wardle (1984) gives a thorough account of the distribution of native southern beech forest in New Zealand, as influenced before human settlement by natural forces including fire.

We can safely say that volcanic activity has been happening in New Zealand for a very long time. Our country is littered with evidence of past volcanic activity, and old "extinct" volcanoes are attractive parts of our landscape (NZ Historical Atlas 1997).

Pumice deposits through most of the North Island and some of the South Island have been named after the eruptions that are thought to have deposited them – names like Rewa (1.29 million years ago), Potaka (1 million years ago), Kaukatea (0.87 million years ago) and Kupe (0.64 million years ago) (Alan Palmer, NZIF Conference field trip 2008).

The so-called Taupo eruptions of 1800 to 26,000 years BP were numerous events, but merely part of an on-going sequence of events beginning at least 300,000 years ago, and were among the most substantial volcanic eruptions in the world. The climatic effects of the 1800 BP event was recorded in Chinese history as a result of the haze caused by the ash in the upper atmosphere, which circled the globe for a few years and caused poor crops in the northern hemisphere. We understand that the same event, which also caused a famine in ancient Rome, led to one of the Caesars being tipped out of office. While this event holds the gold medal for the last 5,000 years, this was only one tenth the size of the Oranui eruption which formed Lake Taupo 26,000 years ago.

And of course, more recently we have had the 1886 Tarawera eruption which, due to the relative recent arrival



Figure 3. Tikitapu lake after the eruption of Mt Tarawera which destroyed vast areas of native forest in 1886 - picture from Halkett p16.

of mankind to New Zealand, also was the first known to cause loss of human life in New Zealand, killing 150 people (Figure 3). The grumblings of the still-active Tongariro and Ruapehu, and the thermal activity in Rotorua and the wider central North Island, are constant reminders of what may be yet to come.

All of the past volcanic activity has caused fire and destruction of native forests. Halkett (1991) notes: "Volcanic activity in the Central North Islandhad a significant impact on forests. About 1800 years ago major volcanic eruptions resulted in a layer of pumice several metres deep, causing catastrophic forest damage. Gradually the devastated landscape was re-colonised by tussock and hardwood scrub, with podocarp forest slowly reappearing. However, beech forest has not yet been able to re-conquer all the ground which it lost during the volcanic holocaust."

Fire caused by lightning is much more difficult to prove because there is no lasting evidence other than charcoal. Evidence has shown that fires devastated the forests of South Canterbury, Central Otago and the Mackenzie Basin somewhere between 1,500 and 2,500 years ago (Dudfield, unpublished). These fires are most likely to have been caused by lightning. Nevertheless, these were probably rare events, as evidenced by the lack of fire adaptation by our native flora, and the long successional recovery periods of New Zealand forests. Indeed, recent evaluation of pre-settlement Holocene (10,000 – 1,000 BP) fire using "radiocarbon-dated charcoals and pollen and charcoal spectra in pollen diagrams" by Rogers et al (unpublished) concludes that fires (caused by lightning) were infrequent and patchy in eastern South Island. Rogers et al suggest "that natural fire was driven more by vegetation flammability than climate within this rain shadow region, that plant chemistry principally determined fire frequency,

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and that topography determined the extent of fire.” Grant (1996), in his review of fires in the Hawke’s Bay region, implies that prior to human arrival, forest fires were rare. Nevertheless, fires remote from volcanic activity did occur, presumably from lightening, and “in the warmer Early and Mid-Holocene, fires from lightening were almost certainly more frequent”. Hamel (2001) also mentions fire as the cause of some deforestation in Central Otago.

2. Evolutionary development of New Zealand flora and fauna

The protracted isolation of New Zealand has meant that about 90% of all native tree and shrub species are found in no other country in the world (Halkett, 1991). Although sharing a common heritage of “mother” genera with other members of Gondwanaland, most of the species that developed within New Zealand over the eons that passed after separation from the landmass did so in a way that made them different from their ‘siblings’ in other fractions of the super-continent. Evolution of a species is a reflection of the external (biotic, climatic – including radiographic - and geophysical) conditions prevailing upon the internal (genetical) character of the species. In summary, a species is the product of its environment, in the widest sense of the word.

Sands (2005) suggests that there are many overseas examples of forest types maintained by fire. Individual tree species may have adaptations to resist damage from fires, to re-sprout after fires, or to promote seed dispersal and germination after fires. Larch, Douglas fir, Acacia and many pines, particularly those with serotinous cones, may be favoured by fire. Jack pine (*Pinus banksiana*) and lodgepole pine (*Pinus contorta*) are good examples of tree species that are very well adapted to frequent burning. The Australian flora has been moulded by fire and has adaptations over the whole range from extreme fire resistance to the opposite where the plant is adapted to be flammable so that it will burn. For example, *Eucalyptus regnans* regenerates in the ash bed after very intense wildfires that essentially ‘clear fell’ the site.

By contrast, New Zealand tree species are unable to do this. The fastest colonisers after a fire are the podocarps, which are spread widely by birds ingesting seed from live trees outside burnt areas, and carrying it to burnt areas where it is deposited after passing through the gut. A seed with a hard, indigestible outer coat sits on top of a fleshy and colourful aril which is attractive to berry eating birds (Figure 4). So podocarps will re-colonise a burnt site relatively quickly, but only if there is a seed source within the range of the birds frequenting the area. Beech seed, on the other hand, has a very small wing, and without water to carry it downstream, falls close to the seed source. If eaten by birds, the seed is digested, and does not survive for colonisation.

Of course, our climate in New Zealand has had a lot to

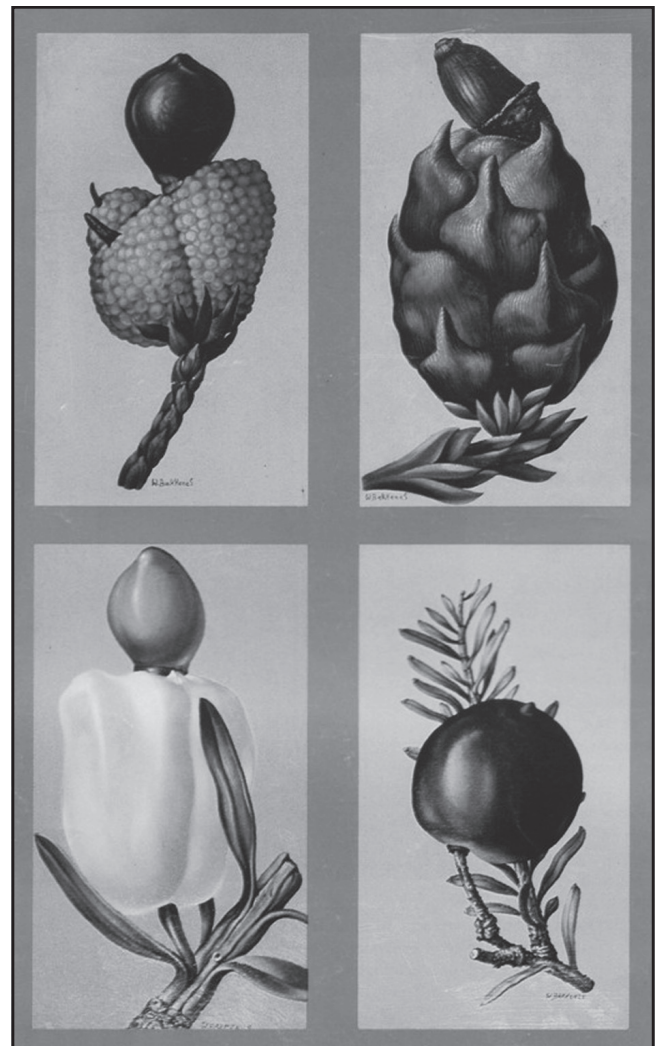


Figure 4. Podocarp “seeds” – cover photo oin NZ Journal of Forestry February 1991.



Figure 5. Picture of Tautuku Beach.

do with the paucity of natural fires. Being an island nation, New Zealand is surrounded by large bodies of water, and experiences a largely maritime climate (Figure 5). Dominant factors influencing New Zealand’s climate are its position in relation to the South Pacific Ocean and the Tasman Sea, and the exposure of its elevated topography to migratory weather systems of low pressure and anticyclones. The mid-latitude westerlies are a predominantly westerly airflow which affects New Zealand for much of the year (NIWA, 2006).

The Southern Alps are a huge modifier of precipitation distribution; the mountainous parts of Fiordland and the West Coast receive in excess of 8000 mm per annum, whereas the driest parts of Central Otago, a mere 70 km away to the east, receive less than 400 mm. The same pattern is experienced in the North Island, but not to such extremes.

Another aspect of the New Zealand climate is the sharp differences in regional climates. The combined effect of the elongated shape of the main islands extending over a large latitudinal range, the mountainous terrain, and variations in distance from the sea has created an unusually large number of distinctive regional climates within a relatively small island nation.

3. Summary of pre-Maori natural causes of fire in New Zealand

Although evidence shows that wildfire events did occur in New Zealand prior to human arrival, it is the predominant view of most ecologists that these were rare, as evidenced by the lack of flora and fauna adaptations to cope with fire, and the long successional recovery periods of New Zealand forests.

Pre-European

1. Maori use of fire, deliberate and accidental

McGlone (1989) claimed that Polynesian settlement of New Zealand (c. 1000 BP) led directly to the extinction or reduction of much of the vertebrate fauna, destruction of half of the lowland and montane forests, and widespread soil erosion. The climate and natural vegetation changed over the same time, but had negligible effects on the fauna compared with the impact of settlement. The most severe modification occurred between 750 and 500 years ago, when a rapidly increasing population over-exploited animal population and used fire to clear the land.

Fire was the first product of the natural world that humans learned to 'domesticate' (Sands, 2005). Hunter-gatherers used fire to manipulate vegetation patterns and continue to do so to the present day. They used fire to increase the area of grassland, to inhibit woody regeneration on grassland, to provide green regeneration to attract grazing animals, to deprive game of cover, to drive game out of cover, and to promote and harvest insects and edible plants. They probably also used fire to produce a fire-safe environment in which to reside.

Maori used fire as a tool for clearing large areas of forest and scrubland for Moa hunting and other purposes. By about A.D. 1600 the most vulnerable animals had become extinct or depleted, and much of the easily burned forest had been cleared and replaced by tussock, bracken and scrub

(Taylor and Smith, 1997). Halkett (1991) agrees, saying that habitat destruction seems to have been a major factor contributing towards the extinction of many native birds. "Polynesians were probably responsible for the demise of all of the 11 known species of moa now recognised. Indirectly, they caused the extinction of other lesser known species of birds."

Elsdon Best, in his reporting of Maori tradition and mythology in *Forest Lore of the Maori* wrote: "In olden times our islands were covered with forest growth; the only open spaces were sterile places whereon nothing would grow. When Kupe and other early immigrants arrived here they lit fires at all places whereat they landed, and so much forest was destroyed, also the moa perished in those fires" (Halkett 1991).

The earliest written record we have of Maori fires was made by Joseph Banks in 1769, who recorded seeing "two monstrous fires" off-shore of Hawke's Bay during Cook's first voyage (Joseph Banks observations The endeavour Journal of 1768-1771, Edited by JC Beaglehole Vol 1, 1973), as reported by Cooper (unpublished).

It is clear that prolonged deliberate forest destruction by burning was practised extensively by Maori. Apart from the use of fire for Moa hunting, several compelling reasons have been suggested (Halkett 1991):

- 1.1 Deliberate forest destruction to clear travel routes, and to keep forest well back from settled and fortified areas to deny ambush cover opportunities to enemies and to minimise the possibility of fire being used as a weapon when a pa was under siege.
- 1.2 Deliberate forest destruction for kumara and bracken fern cultivation. The process, known as swiddening, involved burning the forest edges and planting kumara in the ashes (Taylor and Smith, 1997). After 2 or 3 seasons, the plots were surrendered to the fiercely growing bracken fern whose tangled root mass made further cultivation almost impossible. A new kumara plot would be cleared while bracken root was harvested from the regenerating site. A decade or more later, when the bracken had been succeeded by light shrub-land, the site would be burnt off again for kumara.
- 1.3 Potato cultivation. The introduction of the potato into New Zealand by European travellers sometime around the end of the 1700's resulted in dramatic changes to Maori horticultural practices (Figure 6). The arrival of the potato heralded an immediate and dramatic upsurge in forest clearance. At best, only two or three crops could be harvested from any particular location before the fertility of the soil was depleted. But not only did the potato provide an important new source of food for Maori, it was also used in trade to barter for other goods (Halkett, 1991) Potatoes grew best in soils cleared of virgin forest rather than regenerating scrub, so widespread potato 'swiddening' led to renewed deforestation (Taylor and



Figure 6. Maori cultivating potato and maize garden – picture from Halkett p 19.

Smith, 1997). Maori contact with European traders increased markedly over the period from the late 1700's to the early 1800's, when settlers arrived to stay.

2. Summary of the effect of Maori colonisation on New Zealand's native forests.

Prior to the arrival of Maori, it has been estimated that approximately 80% of the land cover in New Zealand was native forest. By the time Europeans arrived to settle in the 1830's, the native forest cover had been reduced to about 55% (Taylor and Smith, 1997). This impact on the native forest was almost entirely attributed to deliberate and accidental burnings by Maori, with natural causes (lightning and volcanoes) probably causing very little loss of forest. Forest loss was rapid between 1300 and 1500, during the main period of Maori expansion, levelled off to the late 1700's, and sped up again in the late 1700's when potatoes became an important introduction to the Maori diet and trade (Figure 7). Recent estimates of the total population of Maori in New Zealand, based on a range of archaeological

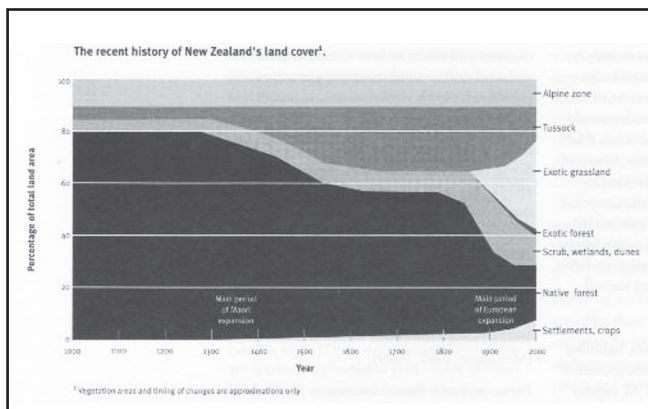


Figure 7. The recent history of New Zealand land cover, from *The State of New Zealand's Environment* graph 8.3 page 8.29.

evidence, puts the population at no more than 80,000 in 1769 (Taylor and Smith, 1997).

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Acknowledgements

The authors wish to acknowledge the helpful comments on the draft manuscript provided by John Purey-Cust.