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Native Forests for our Future | Hereherea te Wao-nui-a-Tāne

Establishing Native Forests

TĀNE'S TREE TRUST FACTSHEET SERIES

Resilient native forest in an era of climate change

FACTSHEET 16, 2024 – by Jacqui Aimers

Refer to the other factsheets in this series for more about successfully establishing native forests.

Online version of this document with clickable links: https://docs.tanestrees.org.nz/1575/

Puketi forest, Northland. Healthy, resilient native forest is complex, with multiple tiers including a well-developed understory and forest floor, and typically has high biodiversity values for flora and fauna.

Introduction

Greenhouse gas emissions are significantly altering the composition of the atmosphere and changing the global climate. Deforestation has also had a significant impact as fewer trees mean less absorption of carbon dioxide, plus there is the loss of shade and the cooling effect of evapotranspiration. Establishing new forests and protecting existing forests aids climate change mitigation (via carbon sequestration) as well as adaptation (e.g., flood protection, moderation of the local climate, land stability and catchment protection).

Internationally, there is growing evidence that climate change is causing changes to weather patterns, including increasing temperatures and altered rainfall. The expansion of forests is a major means of countering climate change, concurrent with reductions in emissions. However, there is major concern about the effects of climate change on forests, including increased drought and heat stress, and increased pest and pathogen problems. In some cases, these factors have been implicated in forest dieback (see Aimers 2021).

First, this factsheet looks at the predicted changes for our climate and how this is likely to impact existing native forest and the establishment of new native forest. Secondly, it looks at how our native forests are important for climate resilience. Finally, it considers measures required to make our native forest more resilient.

Predicted changes in New Zealand's climate

- Warmer air and water temperatures – the average global air temperature has already increased by at least 1.1°C since 1880, according to NASA's Goddard Institute for Space Studies.
- Modelling by NIWA scientists for climate change scenarios for New Zealand, estimates projections for future warming ranges from 0.2-1.7°C by 2040, depending on possible pathways for concentrations of greenhouse gases in the atmosphere.
- Our climate and our marine and coastal ecosystems are already being altered by marine heat waves, according to NIWA scientists.
- Predicted increased intensity of extreme weather, e.g., storm events.
- Predicted increased severity and frequency of drought, particularly in the already dry northern and eastern regions.
- Significant changes in rainfall patterns, including a rise in extreme rainfall, decreased rainfall in the north and east, and increased rainfall in the south and west.
- Sea level rise – there was a 14 to 22 cm increase from 1916 to 2016, depending on the location, with predictions of further increases for centuries to come.
- Increase in extreme wind speeds, particularly in the southern half of the North Island, and throughout the South Island.

Regional impacts of climate change

Climate change will have varying effects across New Zealand, so it is important to understand regional impacts. NIWA has published climate projections at the regional level. They have an online tool for exploring temperature and rainfall projections.

You can check projections for climate variables for any location in New Zealand, for various emissions scenarios between now and 2100 via the online tool – Our Future Climate New Zealand.

Dieback in tawa forest at Pukemokemoke Reserve, Waikato, after the summer drought of 2019/2020. Death of tree ferns in the subcanopy was also observed. Forest dieback was similarly observed in Auckland and Northland regions, particularly in taraire trees.

Impacts of climate change on our native forests

Most of the research in New Zealand on the impacts of climate change on forests focuses on the exotic plantation forestry. However, irrespective of whether forests are exotic or native, these impacts are likely to have many flow-on effects. Examples of impacts include:

- Extreme weather events will lead to more erosion on steep and unstable slopes, highlighting the risks associated with some land uses, including clear-fell forestry regimes.

- The speed of climatic change has the potential to destabilise the natural distribution and patterns of abundance of our native species, and therefore forest composition, as some species may not have time to adapt.
- There will be increased wind and storm damage to forests.
- Fire risk in some areas will increase because of hotter, drier, and windier conditions. This will be particularly a concern in regenerating shrubland where there are highly or moderately flammable species such as gorse, manuka, and kanuka.
- Pest numbers, pest distribution and incursions of new pests will increase in our native forests, as will the costs of pest management.
- There will be increased incidences of forest dieback due to drought, increased temperatures, and increased pest numbers.
- It will be harder to successfully establish forest in periods of drought.

An aerial image of erosion and sedimentation caused by Cyclone Gabrielle in Hawkes Bay (selected from aerial data provided by LINZ Data Service). According to a Manaaki Whenua Landcare Research report, the reduction in landslide probability during Cyclone Gabrielle, in land clothed in woody vegetation, was substantial in Hawkes Bay through to Tairawhiti, particularly where there was indigenous forest cover.

Native forests for climate resilience

Not only are native forests important for carbon sequestration, they also play a critical role in climate change adaptation. This is one of the reasons why it is important that we manage our native forests to increase resilience in a rapidly changing climate.

Examples of how our native forest plays an important role in climate change adaptation includes:

- Green fire breaks and fire-resistant native forest – countering the increased risk of wildfires.
- Prevention of erosion and landslides – even more important due to more frequent extreme weather events.
- Riparian areas, green infrastructure and flood protection – riparian vegetation decreases peak flows and moderates flood events. Green infrastructure utilises natural and restored ecosystems, as opposed to manmade infrastructures, to take the pressure off downstream stormwater systems, alleviating flooding, and protecting water quality in urban areas.
- Coastal buffers – indigenous coastal forest buffers provide sustainable and effective permanent barriers mitigating the effects of sea level rise, and salt and wind damage. Unfortunately, natural coastal vegetation has been cleared from much of our coastline, with almost total removal of dune forest.

Increasing the resilience of our native forest

We must make it a priority to maintain healthy, biodiverse native forest, to mitigate the impacts of stressors such as extreme weather events, invasive weed species, pests, diseases and loss of ecologically key species. Degradation and fragmentation of our native ecosystems tend to amplify the sensitivity to climate change and associated stressors. Linking up forest fragments and connecting native forest to other natural ecosystems such as wetlands and coastal vegetation will help create more resilient ecosystems.

Complex multi-aged, permanent forest, or uneven-aged forest managed through single-tree selection are likely to be more stable in high winds compared with even-aged plantations.

Planting in drought-prone areas

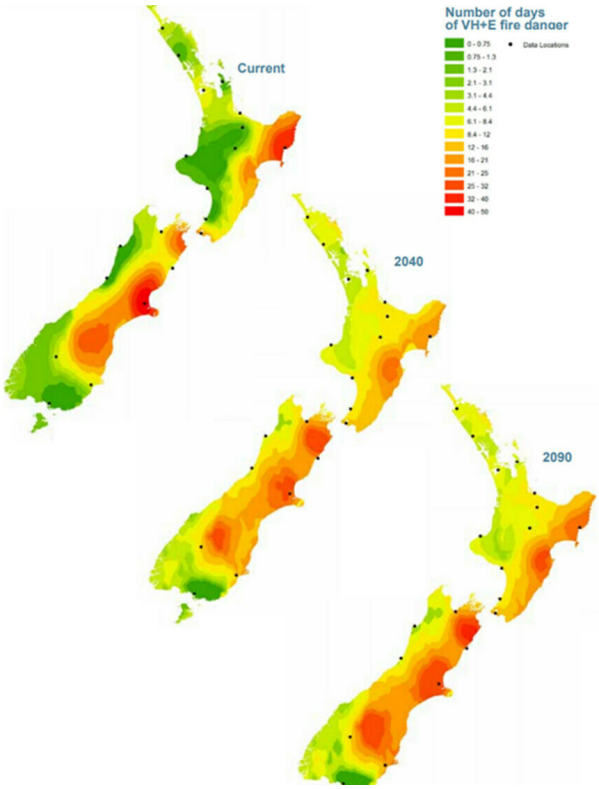
Some tips for planting natives in drier areas of New Zealand to reduce risk of losses from drought include:

- Make sure exposure to wind and sun is minimised when selecting your planting site.
- Understand the limitations of soil type and match species selection to suit.
- Include hardy species in your planting mix – see what is growing well locally and talk to your local native nursery expert, council staff, or whoever is supplying your planting stock.
- If you would like to plant drought-susceptible species like taraire (because, for example they are a great source of food for kereru), place them in more sheltered areas with higher soil moisture.
- Use hardy, fast-growing, native shrub species as a nurse crop, or possibly exotic species, which may already be present on the site and could be left to provide shelter. Refer to Factsheet 8.
- Ecosourcing maximises survival through adaptive advantage, i.e., ensuring the best fit for the local environment. This is particularly important in an era of climate change. Check out Factsheet 2.
- Preferably order plants at least 2 years in advance and request ecosourced seedlings. This will allow time for seed collection in the local area and ensure that your plants are better adapted to environmental conditions at the planting site.
- There is some argument over whether intervention and manipulation of species distribution should be considered to take the effects of climate change into account. Regardless, applying ecosourcing principles will increase adaptive advantage.
- Purchase good quality plants. Provide written specifications when you order, i.e., appropriately ecosourced, size of stock, condition of roots (well developed and free of root distortion), height of plants, stockiness (root collar diameter), general health and form, and hardening-off. Refer to Factsheet 18.
- Large well-conditioned plants (at least 50 cm tall with well-developed root systems) which are thoroughly hardened-off are generally needed for harsher sites.
- For small scale planting, mulching and watering of new plantings during dry spells, where possible, will improve survival. However, irrigation and mulching are not practical for large-scale planting programmes.
- Field trials to date indicate that absorbent gels and wetting agents may have limited efficacy in dry conditions.
- Minimise the impact of other stressors, i.e., keep out grazing animals with fencing, and control pest animals that browse both planted natives and natural regeneration.

Preparing for more frequent and severe wildfires

Wildfires have always occurred but they are predicted to become more severe and frequent due to increased temperatures, more frequent and severe droughts, and windier conditions in many regions because of anthropogenic climate change – as described in a Scion publication on Future Fire Danger.

Large, intense wildfires, similar to what was experienced on the Port Hills in 2017 and in Pigeon Valley near Nelson in 2019, are likely to become more common in parts of New Zealand. A doubling of fire danger is predicted for some areas, with the greatest relative changes predicted for areas where the current fire dangers are comparatively low, e.g., coastal Southland and Wanganui. However, in a few areas fire danger will remain unchanged or even decrease due to increased precipitation.



Projected changes in average number of days/year of Very High and Extreme (VH+E) fire danger each fire season (Oct-Apr), left: climate in 2011, centre: the 2040s, right: the 2090s. From Rural Fire Research Update, Nov 2011, Issue 9, published on the Scion Research website (Scion 2011).

Green firebreaks and fire-resistant forest – defence against wildfires

We can manage native forest to increase fire resistance, by considering the following factors:

- Healthy native forest is quite resistant to all but the most intense fires because the understory is thick with shrubs, ferns, seedlings, saplings, lianes, epiphytes, mosses and liverworts.
- Intact native forest, even on a hot, dry day has a microclimate of cooler, moister air created by shade and evapotranspiration and therefore increased resilience to fire.
- In many areas, the bush is often an eaten-out remnant of what was once a self-sustaining forest and has a lot of standing dead wood and dried fern fronds.
- However, with pest control and fencing out grazing stock, the understory can begin to re-establish and fire resistance will subsequently improve.

Green firebreaks are one option for countering the increased risk of wildfires:

- These strips of low-flammable plant species are grown at strategic locations in the landscape, to help slow or even stop the spread of wildfires.
- These strategic locations could include wildland-urban interfaces, around homes and buildings in rural settings, in shelterbelts, or interspersed throughout plantations of more flammable species such as mānuka, kānuka, eucalypt species and radiata pine.
- Many native species have low flammability and are suitable for green firebreaks.

However, some our most common native species such as widespread early successional species like mānuka and kānuka are highly flammable.

Construction of green firebreaks

Properly constructed green firebreaks are effective, long-term, low-cost tools for fire suppression that complement more traditional approaches and can potentially meet other objectives, such as biodiversity enhancement. Considerations when designing and planning a green firebreak include:

- Plant or encourage natural regeneration of a multi-layered structure from ground cover to a closed canopy to create a cooler, wetter and shadier microclimate.
- Include a high proportion of low-flammability native shrub and tree species.
- Aim for a width of at least 10-12 m and up to a 60 m on steep slopes as fire travels more quickly uphill.
- Control pest browsing animals and fence out grazing stock to protect the understorey, preventing it from being opened up and dried out.
- Establish in conjunction with natural features such as ridges, waterways or gullies, and where practical other man-made or managed fire breaks such as zones of bare soil or regularly mown grass.

Green firebreaks are increasingly being implemented in many countries. For instance, research from China shows that properly constructed green firebreaks (layered forest structure with a closed canopy, planted perpendicular to predominant wind direction) are more effective than conventional fire breaks.

Suitable species for green firebreaks

For green firebreaks to be effective, species with low flammability need to predominate. They are fire-resistant but not fire-proof. All vegetation will burn if conditions are very dry and if fires are hot enough and fanned by winds, but low flammability species do not readily ignite and will slow the progress of fires.

Guides to Flammability of Plant Species and Landscaping for Fire Safety are provided by Fire and Emergency New Zealand with lists of highly-flammable through to low-flammable species.

Species with low flammability have the following characteristics: moist, supple leaves; little dead-wood or dry material accumulating within the plant; watery sap that does not have a strong odour; and low levels of resin.

Native species with low to low/moderate flammability

Understorey species:

- kawakawa/pepper tree
- hangehange
- putaputawētā/marbleleaf

Commonly planted shrubs:

- Karamu
- Taupata
- Karo
- Ngaio
- Koromiko

Kawakawa

Other shrubs and small trees:

- Horoeka/lancewood
- Kōtukutuku/tree fuchsia
- Five finger
- Puka
- Kanono
- Poroporo
- Mahoe

Trees:

- Karaka
- Broadleaf (kapuka and puka)

Native species with a low/moderate flammability rating: ngaio (left), mahoe (middle), fivefinger (right).

In establishing natives as a green firebreak, there are a number of factors to consider:

- Native species also provide other values such as biodiversity enhancement, pollination services and cultural values.
- Ease of establishment and management is important - select hardy but not weedy species.
- Fast-growing, early successional native plants such as large-leaved *Coprosma* species with low flammability can be useful in quickly establishing cover.
- Canopy or subcanopy species such as karaka, kapuka, marbleleaf and hinau can be included in the initial mix or planted later.
- Encourage natural regeneration that includes lower flammability species such as kawakawa and hangehange as understorey tiers and poroporo along forest edges.
- Matching species to micro-climates is also important, such as moist gullies (e.g., kawakawa) or drier ridges (e.g., lancewood).

The commonly planted native nurse cover species kanuka (left) and manuka (right) have a high flammability rating.

Highly flammable plants generally have the following characteristics: fine, dead material such as dry twigs and leaves contained within the plant; volatile waxes, terpenes or oils; gummy, resinous sap with a strong odour; aromatic leaves; and loose or papery bark.

Native species with moderate/high to high flammability include manuka, kanuka, tree ferns, akeake and totara.

Left: A “zombie forest”, i.e., the understory has been eaten out by browsers. This opens up and dries out the forest, making it more vulnerable to invasive weeds, disease and wildfires. Right: When native forest is fenced to exclude livestock, and there is good pest control, the understory can regenerate. This results in a more speices diverse and resilient forest.

Protecting native forest against pest and disease

Other factors can help reverse native forest degradation and lower vulnerability to wildfires.

Pest animals

- More commitment than ever is required to undertake effective and sustained pest animal and weed control.
- Predators have had a devastating impact on our indigenous wildlife, which has impacted natural regeneration processes.
- High numbers of introduced browsers open up the understory, drying out the forest, making it even more vulnerable to pests, diseases, and invasive weeds, and making the forest more flammable; some refer to these forests with bare understorey tiers as “zombie forests”.

Biosecurity measures

- Biosecurity measures are even more important in an era of climate change and must be maintained from nursery propagation through to planting and forest management.
- Biosecurity New Zealand has advice on how to find, report, and prevent pests and diseases. Advice is also available for current incursions.
- The Kauri Dieback Programme has guidelines including a kauri propagation and planting guide.
- The Myrtle Rust in New Zealand website also provides good information and resources.

Myrtle rust *(Austropuccinia psidii)* is an airborne fungal pathogen that attacks species in the Myrtle family. It was a major biosecurity incursion, first discovered on mainland New Zealand in 2017.

Left: March 2021 photo of myrtle rust spores on rohutu, during the early stages of infection in what had previously been a healthy, attractive hedge. There was evidence of dieback in new leaf and flower buds of most plants. Right: April 2024 photo - just over 3 years since myrtle rust infection was first detected in the hedge. Most of the rohutu plants have since died, though some have a small number of green leaves remaining. No fruiting bodies were seen.

Maintaining a healthy forest is the best defence!

- Weaving more native forest back into our working landscapes will help New Zealand to become carbon neutral by 2050.
- This will also capture co-benefits of biodiversity conservation, protection of soils, better water quality and climate change adaptation.
- Maintaining a healthy native forest is more important than ever - getting the basics right and following best practice in establishing and managing our forest.
- This includes thorough planning and working with Nature to encourage natural regeneration or if planting new areas, ensuring you have good quality, ecosourced stock.
- Ecosourcing maximises survival through adaptive advantage, i.e., ensuring the best fit for the local environment. This is particularly important in an era of climate change.
- Maximising genetic diversity by collecting seed from as many trees as possible is particularly important. This is an important component of ecosourcing principles, which is often overlooked.
- Genetic diversity is particularly important for long-term resilience against diseases, pests, and environmental stressors.
- For the same reason, it is much better to have plants grown from seed to maintain genetic diversity, as opposed to vegetatively propagated material (e.g., cuttings). If plants from the same clone are planted in the same location, there is a high risk of inbreeding depression.

- It is important to keep up pest and weed control and fencing to keep out livestock. A healthy understory is more resistant to drought, fire, disease, pests, and invasive weeds.
- The ultimate goal is to ensure that structurally complex and species-rich forest ecosystems are restored and maintained so that they are resilient in an era of climate change.

Native forest factsheets series

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