KAURI CARE GUIDE

KEEP KAURI STANDING
STOP KAURI DIEBACK DISEASE SPREADING
KIA TOITU HE KAURI

ABOUT THIS BOOKLET

This booklet is for landowners, managers and occupiers with kauri on their land. It explains the ecology of kauri, common diseases and gives advice about care and propagation. This booklet has three main sections:

1. Kauri ecology

We describe the kauri family, how kauri grow and reproduce, and diseases that affect these trees.

2. How to care for your kauri

We give advice on how to reduce stress and care for your kauri.

3. How to grow kauri

We describe how to gather seed, propagate and plant out kauri.

A glossary of terms used and list of further reading is also included.

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Disclaimer

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CONTENTS

PROTECTING KAURI

Kauri are under significant threat from kauri dieback disease, caused by a microscopic, soil-borne pathogen known as *Phytophthora agathidicida* (or PA).

The PA pathogen damages the tree's root system, reducing its ability to take water and nutrients from the soil and transport it throughout the plant.

There is currently no cure for kauri dieback, which kills most if not all the kauri it infects. The disease is spread through soil movement, including through human activity. This means that when planting trees, visiting forests or undertaking any activity around kauri, following good hygiene and biosecurity practices is critical.

There is a strong focus is on containing kauri dieback disease within its current locations and stopping its spread into healthy areas.

Kauri can be saved if everyone plays their part. This means working together to stop it from spreading, through strong biosecurity practices.

- Making sure when visiting areas with kauri that footwear, tyres and equipment are cleaned of all soil and plant material before AND after your visit.
- Keeping stock out of kauri areas.
- Ensuring people visiting your property have soil-free footwear and machinery.
- Contacting the **Kauri Dieback Hotline 0800 NZ KAURI (695 2874)** if you think a kauri tree is showing symptoms of kauri dieback disease on your land.

For more information, visit: **kauridieback.co.nz**

1 KAURI ECOLOGY

THE KAURI FAMILY

The New Zealand kauri *(Agathis australis)* belongs to one of the world's oldest families of conifers, the *Araucariaceae* family, comprising 21 tree species. Kauri is the largest of the *Agathis* genus, and is endemic to New Zealand.

Many of these great forest giants were felled by early pioneers for their high quality timber. One of the largest kauri trees ever recorded was Kairaru of Tutamoe, with an estimated diameter of 6.4 metres and a height of 65 metres. Unfortunately, Kairaru was destroyed in a fire before 1900.

The largest kauri alive today is Tāne Mahuta, found in Northland's Waipoua Forest. It has a diameter of 4.6 metres and height of 52 metres, and is estimated to be between 1200 and 2000 years old.

Simulated comparison of Tāne Mahuta (left) and Kairaru (right).

PART OF NEW ZEALAND HISTORY

Cultural significance of kauri

Kauri are considered a taonga by many New Zealanders, particularly Māori, who see the health of kauri as a sign of general wellbeing - hence their value cannot be understated.

Kauri play an important role in Māori culture, through cosmogeny and ceremony, for use as weapons, tools, shelter and transport, and in many other aspects of everyday life. Many larger kauri are given names and revered as rangatira (chiefs) through their ability to bring together and support numerous other living creatures, as do chiefs or leaders of any culture and society.

When required, particular kauri were felled and carved into waka (canoes) for various purposes – sea-voyaging, fishing, trading and transporting war parties to name some. This latter type, waka taua (war canoe) are commonly seen today on ceremonial occasions.

Kauri gum had many valuable functions. Gum was burnt as an insecticide for kumara gardens, wrapped in flax for use as torches at night, and also as kāpia or ngaungau (chewing gum). Kauri resin was also burnt and mixed with fat and/or charcoal for tā moko (tatooing).

Bushmen watching a large kauri fall, Dome Valley, 1952.

Early European influence

By the mid-1900s, early Europeans had developed a thriving timber and gum industry based on kauri. Large areas of kauri were felled for their timber, which was valued for its strength and ability to withstand seawater conditions, making it ideal for boat masts and hulls. Above all, kauri wood was knot-free, so was considered perfect for high-end furniture.

Kauri gum was used in varnishes, paint, and linoleum and to create ornaments. Gum was largely collected from the ground, however, some was gathered by deliberately injuring or "bleeding" trees.

Estimates of the extent of kauri forest before European settlement in

New Zealand are between 1 million and 1.5 million hectares. This was reduced to an estimated 7000 hectares (0.5% of original extent) by exploitation for timber or destruction by fire and clearance in the late 19th and early 20th century. An estimated 60,000 hectares of secondary forest and scrubland contain some stands of younger kauri regenerating after this harvest.

DISTRIBUTION OF KAURI

Naturally occurring kauri are found throughout the warmer regions of the upper North Island, above the latitude of 38°S (north of Kawhia/Hamilton/Tauranga).

This means if you're in native bush in the Northland, Auckland, Waikato or Bay of Plenty regions, then you're likely to find kauri.

Current distribution of kauri in New Zealand.

The site, soil and temperature determine the type of forest that can naturally contain kauri. There is no "typical kauri forest": kauri can exist as solitary trees in broad leaf dominant bush, or together in dense stands.

Kauri require high levels of light to grow, but they can tolerate low soil nutrient levels. Kauri seedlings are often suppressed under dense canopies of faster growing species in fertile soils. Consequently, they are often restricted to less fertile soils on ridges, or can establish themselves en masse after a large disturbance such as a fire.

In a forest environment, mature kauri emerge above the canopy of other native trees. The lower forest can contain a variety of other native tree species, including tōtara, tānekaha, taraire, tawa, miro and rewarewa growing alongside juvenile kauri.

At the shrub level, a range of plant species can be found, including tree ferns, nikau palms, lancewood, hangehange and mingimingi. Kauri grass (a species of *Astelia*) is commonly found covering the ground below kauri.

A range of orchids and epiphytic plants are also often found growing amongst the branches of mature trees.

REPRODUCTION

Kauri reproduce through cones, which are formed every year, starting on trees from 20–40 years of age.

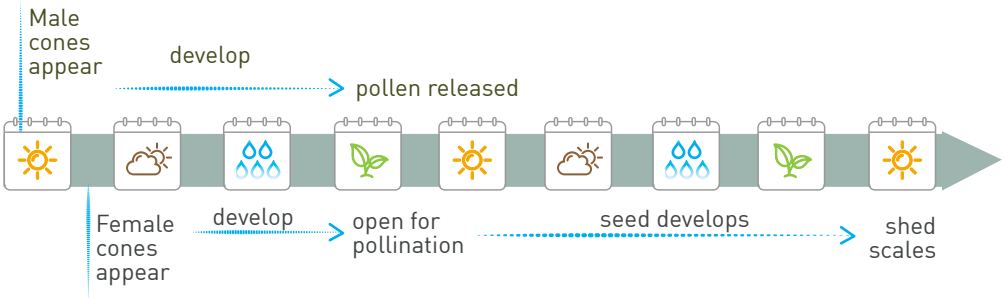
Kauri trees have both female and male cones.

Male cones release pollen which is carried by the wind to fertilise the female cones. Seeds then develop over a two-year period within female cones, with one seed attached to each scale of the cone.

Up to 100 seeds can be released from mature cones, although on average only half of these will typically survive.

Rod-shaped male cones and ball-shaped female kauri cones.

Kauri seeds with wings.



Kauri seeds rely only on the wind to be dispersed and have a small wing which enables them to catch even light winds. A gentle breeze can carry seeds 100–150m from the parent tree, although distances of up to 1.5km have been recorded.

Kauri seeds lose their viability over a few months and are easily damaged by the cold and wet. Seeds need to land on soil to germinate. A viable seed needs favourable conditions, including good light, moisture, warmth and easily accessible soil nutrients, which are generally not found under the parent tree. If the seed reaches suitable conditions, germination takes place within 10–20 days.

Young ricker stand of kauri.

Female kauri cone.

HOW OLD IS MY KAURI?

It is not always easy to age kauri trees. The growth rate, final height and life span of kauri depends on the growing conditions. Growth is also suppressed in areas with compacted and poor soils, competition from other plants and lack of overhead light.

However, in all conditions kauri trees have three main stages of growth.

1. Kauri seedlings emerge as two-leaved cotyledons (germinating seeds) and develop into bushy seedlings. The colour of these young trees can be green or a red-bronze depending on the amount of rhodoxanthin (red) pigment present in the leaves. Both red and green seedlings are equally healthy, and red seedlings will turn green as they mature into the typical cone-shaped saplings.
2. In its "teenage years" kauri tree growth is focused upwards towards the canopy of the forest. Like humans, kauri develop into gangly teenagers with long slender bodies/trunks. During this stage (usually 30–50+ years) kauri are self-pruning. They begin to drop the lower, shaded branches in a process known as "abscission", which leaves the trunk without knots or scars.
   These pole-stage trees, or "rickers", become free of branches on the lower trunk and have narrow, conical crowns.
   As a ricker grows through the forest canopy (> 50 years) it begins to grow outwards, expanding the narrow trunk and crown.

Sapling.

Ricker.

Mature.

3. Mature kauri trees (100+ years) emerge above the forest canopy with large straight trunks (free of branches up to 12–25m), supporting flattened/spreading crowns with large permanent branches that will not normally be dropped.

On average, kauri grow to heights of 30–40m and can live for more than 1000 years, with trunk diameters of several metres. In suitable conditions, kauri aged 400–800 years-old will have diameters of 1–2m (sometimes up to 3–5m).

Small shoots off the main trunk can be found on some mature kauri. These "epicormic" shoots can appear when the trunk is suddenly exposed to increased light levels and/or in stressful situations. These shoots may be a means to gain more energy from the sun to cope with stress.

Kauri typically have one main trunk, but if the growing tip is damaged at any stage (for example, by frost, wind or physical damage), two or more "leader shoots" (trunks) can develop.

Kauri generally have a spurt of new growth once a year in spring, but a second "flush" of growth can occur in warm and wet autumns. In young trees, this new growth is obvious by the appearance of shoots with a blueish tinge. In older trees, this can be seen as bright green foliage.

In crowded sites, kauri will naturally thin themselves, with the weaker trees dying off and the strongest trees surviving.

Epicormic shoot.

Double leader trunk.

Bark

Juvenile kauri have a typically "pimply" bark with a reddish to grey colouring. In mature trees this develops into thick scales which frequently flake off and leave the trunk with a pattern of hammer-like markings or indentations.

Shedding bark is a natural trait which prevents vines from clinging to and smothering kauri. In some cases, trees may shed large amounts of bark at a time and appear unusually smooth. This is thought to be associated with a sudden spurt of growth.

Gum

A small amount of bleeding (gummosis) is natural for kauri trees.

Kauri naturally produce gum as a defence in response to stress. Events such as strong winds, drought, insect attack, large growth spurts and disease can all cause gum to ooze through the bark.

Kauri gum also acts as a natural bandage to seal physical injuries and prevent infection by insects, fungi and bacteria.

Kauri with more than one leader shoot (two or more main trunks) often bleed gum from the joint in response to injury caused by wind stress.

In the late 19th century, some kauri were deliberately injured to increase gum production for collection and export. Bleeding of kauri was banned in state forests from 1905 after it was shown that it caused damage to the trees and a decline in health. There are still trees alive today that show scars from injuries caused by early gum collectors.

Juvenile kauri bark.

Mature kauri bark.

Roots

Kauri seedlings have a fine lateral root system associated with one main 'tap root'. In some cases, this can be up to three times longer than the height of the seedling. Tap roots continue to develop in young trees, reaching up to 2m deep.

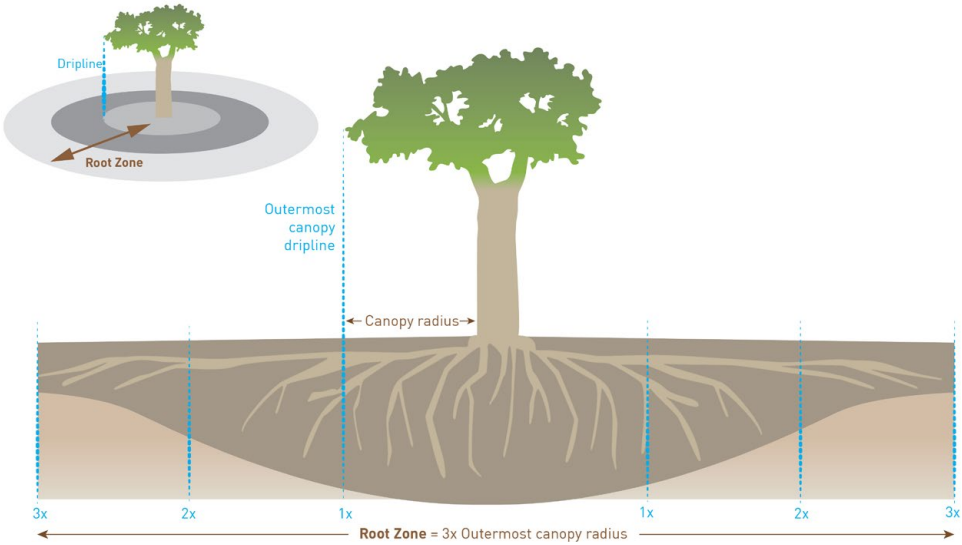
The root system develops to incorporate three different kinds of roots in mature kauri trees. Large lateral roots spread out from the base of the trunk with deep "peg" roots running off these (up to 5m deep) to anchor the tree to the ground. A network of fine "feeder" or surface roots run up from the laterals into the thick layer of litter in the forest to absorb nutrients.

Kauri are able to grow in dry areas with low nutrient levels through the help of mycorrhizal fungi. These fungi, attached to the roots of kauri trees, significantly increase the ability to absorb water and nutrients.

The root zone of mature trees extends out at least as far as the canopy is wide.

In dense areas, the root zones of neighbouring kauri may overlap – in these situations the lateral roots of neighbouring trees can fuse. This trait can result in the re-sprouting of kauri from stumps once cut down.

Soil nutrients are largely absorbed by the delicate surface roots of kauri – if the health of the surface roots is compromised through damage/ disturbance (for example, trampling or digging), the health of the whole tree can decline.



KAURI DISEASES

It is natural for kauri to bleed small amounts of gum and shed bark. However, there are some diseases that you should look out for.

Kauri dieback disease

Kauri dieback disease is highly pathogenic and can infect and kill kauri of all ages, from seedlings to large trees.

There is no cure for kauri dieback disease, the disease kills most if not all the kauri it infects. It can be spread by just a pinhead of soil, and you can't tell just by looking whether a tree is infected or not.

The injection of phosphite into the trunk of an infected kauri can help keep the disease at bay, but it is not a cure.

Preventing the spread of kauri dieback disease to healthy trees is the primary way landowners and managers can protect their kauri.

The best defence is to make sure footwear, tyres and equipment are clean of soil before and after visiting kauri forest. Consider using dedicated footwear and tools that never leave your property. Ensure all visitors arrive with soil-free footwear and gear and that they are thoroughly cleaned prior to visitors departing. Keep stock out of kauri areas, and undertake feral animal control.

There are several physical symptoms of kauri dieback disease. Although the absence of these signs doesn't mean a kauri tree is healthy, it is worth keeping these symptoms in mind.

Assessing kauri trees for symptoms is critical in finding where the disease is located. The most common symptoms associated with kauri dieback disease can include:

Globs of gum (left), develop into large bleeding lesions (right).

- **Bleeding gum:** Basal trunk lesions or "bleeding" of gum can be a symptom – although not all infected trees will show lesions, and not all lesions are caused by kauri dieback. This is usually confined to the lower part of the trunk.
- **Yellowing of leaves:** Kauri tree leaves may turn yellow as the disease takes effect.
- **Thinning canopy:** Given the disease damages the tree's fine feeding roots, it prevents the movement of water and nutrients throughout the tree, the canopy is eventually reduced or thins out over time. The degree of thinning can vary.
- **Dead branches:** Dead kauri trees and trees showing severe dieback-like symptoms such as a thin canopy and dead branches. The last stage of kauri dieback disease is death of the tree itself where there is no canopy of the tree. Most trees infected will eventually die.

Kauri dieback disease can take years to show, so treat every tree as though it is infected.

Other diseases

Phytophthora cinnamomi: This introduced soil pathogen is now found throughout New Zealand. It affects many plant species, particularly plants that are weak or stressed. A slow decline in health, occasionally with small scattered bleeds up the trunk can be caused by the disease. In kauri trees, *P. cinnamomi* infection causes damage to the feeder roots of kauri, however, the impacts are not as severe as *P. agathidicida*.

Damping off: This root rot disease is caused by a range of microbes common in poorly drained soils. Signs include yellowing and wilting of leaves, and death of seedlings. Strict hygiene in nursery situations is essential to avoid this disease.

Core rot disease: This often affects large mature kauri trees, rotting the heart wood, leaving the giants hollow inside and causing a slow decline in health. Core rot is caused by several different species of native wood-rotting fungi. Physical damage to younger kauri can also allow core rot fungi to enter and infect the inner tissue.

Cone disease: Warm and wet summers can give rise to the infection of cones by the *Pestalotiopsis funerea* fungus. This reduces seed viability and can cause cones to drop prematurely.

Leaf disease: Kauri leaves are affected by the fungus *Vizella tunicate*, which causes small black spots on top of the leaves. Damage is normally superficial and will not cause a major decline in the health of the tree. Leaves may also be affected by *Trichopeltheca asiatica*, a sooty mould which can live on secretions from insects. This mould covers the leaves in black soot but does not cause any physical damage.

Armillaria mellea: Kauri can be affected by this introduced fungus. The symptoms of this fungus include poor canopy health and bleeding in the lower to mid trunk area.

Insect and animal pests

Both native and introduced animal species use kauri trees as a food source. At the seed stage, the ripening cones of kauri are often broken open and eaten by kaka in the forest. Ripe seed that falls to the forest floor may be eaten by the common weta, ground-feeding kakariki, the Australian rosella, mice and rats. This effectively reduces seedling regeneration.

Throughout their lives, the root systems of kauri trees are easily damaged by feral goats, pigs and stock. Such damage can lead directly to loss of health and injury points can be entry points for various diseases. In order to maximise kauri health, effort should be made to control non-native pests.

Although kauri leaves are leathery and resilient to many pests, they can suffer feeding damage from weevils, caterpillars of kauri leaf rollers, the kauri leaf miner and the bronze beetle. Such insect damage is usually superficial and will not cause a decline in otherwise healthy kauri.

Feeding damage from insects is usually superficial and will not cause a decline in otherwise healthy kauri.

2 HOW TO CARE FOR YOUR KAURI

Although they can live for thousands of years in their natural environment, kauri are sensitive to stress. The likelihood of disease and early death can be minimised by reducing any stressors and enhancing the health of kauri. With some care your kauri can live to a grand age and grow to great heights.

Kauri need:

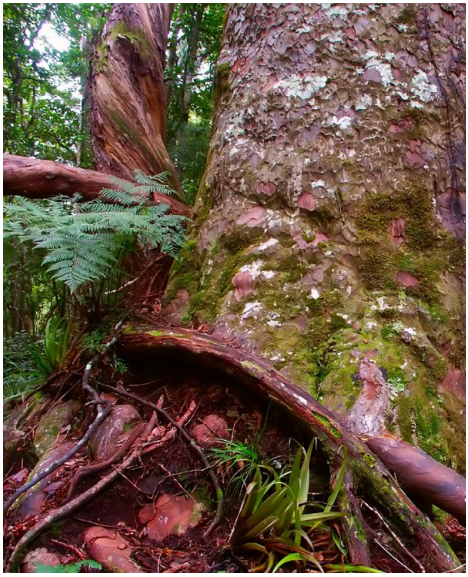
- healthy root zones
- nutrients
- water
- shelter
- sunlight
- room to grow.

"Keep off the feet"

The surface feeder roots of kauri are delicate and easily damaged. For maximum tree health, the root zone must be healthy and undisturbed. Where possible, keep away from the root zone, including where kauri have been planted as specimen trees, for example, at car parks and next to driveways.

Avoid any disturbance to the soil in this area including digging, walking, mowing and building. Any existing compaction around trees should be carefully removed where possible (for example, re-route tracks away from kauri). Avoid planting exotics within the dripline of kauri – not only are kauri delicate but they are particular about what lives in their vicinity.

Ideally, tracks or buildings should be at least a few metres out from the "drip zone" of kauri trees (keeping in mind this zone will increase with age and growth). In parks, installing boardwalks will allow for safe access to kauri forest while minimising disruption to the soil around the tree. Other track materials, such as reliably sourced bark chips or a bark/gravel mix can also provide a suitable environment for kauri roots and minimise compaction. Only source material from a supplier who is accredited through New Zealand Plant Producers Incorporated (NZPPI), or who has developed sound biosecurity practices.



Kauri growing in paddocks with stock normally suffer root compaction and damage. Trees in agricultural situations therefore benefit from being fenced off from stock to prevent the trampling of their roots.

Consider covenanting native forested areas – which in most cases includes a requirement to fence off such areas to prevent stock from entering.

Fencing will also allow natural mulch to build up and soil health to improve. If fencing around kauri, be sure to allow sufficient distance out from the tree to protect the root zone – it is recommended that an area at of least three times the size of the drip canopy be created to protect the root system.

To help protect and enhance stands of kauri, consider planting a buffer around the outside of the trees using plant species naturally found growing in and around kauri, remembering to allow sufficient room for growth. This will help to provide shelter and protection for the trees and increase humidity in the stand, which will encourage natural regeneration. If funds are limited, focus planting on the side of the prevailing winds. Ideally you should use eco-sourced species that are hardy and fast-growing and are from non-kauri dieback infected areas. Contact your local or regional council for advice on the best species to plant for your area.

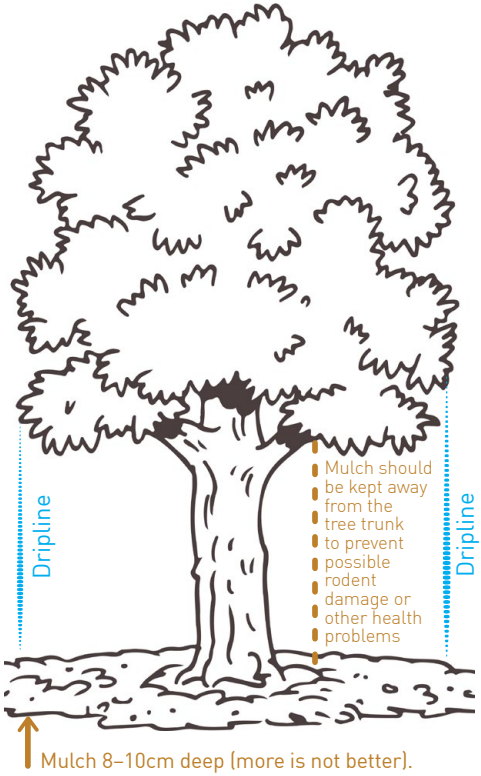
Mulch

Kauri benefit from mulch around the root zone. Mulch holds moisture in the soil, insulates the soil and minimises weed growth, creating a good environment for the growth of feeder roots.

In natural forests, kauri provide their own mulch with large amounts of litter (up to 2m deep).

In urban and agricultural situations, this natural litter is often removed or blown away. In some cases, this can lead to exposed roots which are susceptible to damage and disease. Organic mulch such as fine bark chips and straw can be placed around the root zone to improve root health.

- Wherever possible, leave any fallen leaves and branches where they fall, as this mirrors what occurs naturally in the forest. If you find this unsightly, you may wish to mulch this material and place it around the base of the tree, which will help keep the kauri healthy.
- If adding mulch, it should not be placed up against the base of the tree and must be relatively dry when applied.
- For established trees in urban situations, a 10cm deep layer of fine mulch (in a diameter up to 2m



Forest litter provides a natural mulch.

around mature trees) is ideal. Again, only source mulch and/or fine bark chips from a supplier who is NZPPI accredited or who has developed sound biosecurity practices.

- Synthetic weed mats are not a good option around kauri – although they prevent weed growth, they do not decompose, so prevent the feeder roots growing up into the rich organic layer.

NB: Mulch should not be added around kauri in wet areas as this can cause further water logging of the soil and may promote root diseases.

Soil nutrients

In natural conditions, kauri trees diminish soil nutrient levels and increase soil acidity. Kauri are tolerant of low levels of soil nutrients, but growth and health can be enhanced by ensuring nutrients are plentiful and competition is minimised.

Kauri will grow best if they are not suppressed by dense competition. Kauri should be situated 5–10m from other large trees to reduce overcrowding.

Research has found that growth of kauri occurs best in soils with a pH between 4.8 and 6. Lime is not required unless the soil acidity is below pH 4.5. A simple soil acidity test kit can be bought from plant shops if there is concern that soil acidity may be affecting growth.

Water

Seedlings and young kauri trees with developing root systems are susceptible to drought. Mature trees, although well known for being more drought tolerant than many other native plants, will also suffer during long dry periods. To minimise drought stress, a solid water once a week is beneficial, especially for young trees. (As a rough guide, a few hours a week with a soaker hose over summer should be adequate).

NB: The water requirements of kauri will depend on the site and soil conditions. Care must be taken to prevent over-watering, especially in areas with compacted or clay soils. Root diseases are more likely to infect trees in waterlogged soils and cause early death.

Provide some company...

Kauri don't like being alone or on the edge of bush – they like to have some company around them. Even in natural stands of bush, kauri trees on the edge will suffer from a loss of health, and occasionally death, from being exposed to the elements (also known as the "edge effect").

A range of native species are commonly found growing in association with kauri and can be planted to provide shelter for trees growing in open areas. Suitable companion plants include kānuka and mānuka, which are useful pioneer or nurse crop plants that rapidly provide shelter for young kauri while still allowing access to light. Other suitable companion plants include akepiro *(Olearia furfuracea)*, māpou *(Myrsine australis)*, mingimingi *(Leucopogon fasciculatus)* and shining karamū *(Coprosma lucida)*.

Shade cloth can be used as a temporary wind break option.

Suppressing weeds to allow for natural regeneration of companion plants will help kauri to establish within existing bush areas.

....but don't crowd.

Care should be taken to minimise competition for sunlight and soil nutrients. If planting other large tree species (for example, pūriri, pōhutukawa, kahikatea) nearby, ensure there is adequate space for future growth. Allow at least 3–10m between these species and kauri trees.

As a slow growing plant, young kauri can easily become suppressed by a dense canopy of faster growing plants. Access to overhead light is essential for growth of young trees.

Restored forest showing different spacings of large and small plants.

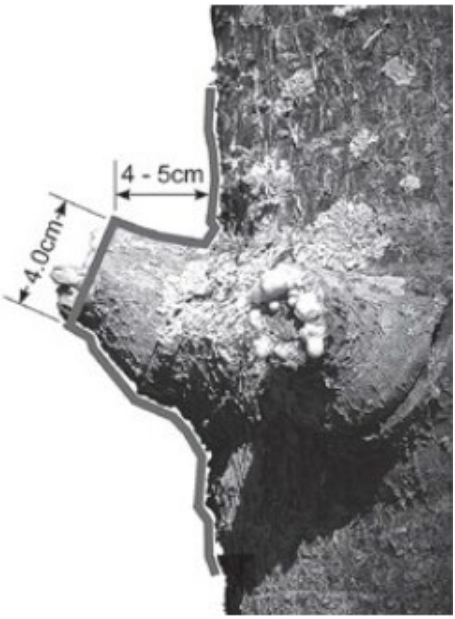
Pruning

Kauri naturally drop their lower branches as they grow toward the forest canopy. However, in open areas the lower branches may be retained.

If a small branch dies on a kauri tree, or if live branches need to be removed, a 4–5cm stub should be left on the tree when cut. This measure encourages the tree to drop the stub naturally (it simulates the loss of energy, similar to that experienced if it became shaded in the forest) without leaving a scar or bleeding wound on the trunk. This method should only be used for branches less than 4cm in diameter. Larger branches should be sawn off close to the trunk.

Wind stress can often cause cracking/ damage at the joint of double leader shoots. Young trees with multiple leader shoots can be pruned back to one main trunk to avoid this.

Consult your local or regional council for instructions regarding the pruning of kauri.



More tips/general care

Herbicides: Take care when spraying around the root zone. Avoid using residual herbicides around kauri.

Weeds: Weeds such as kikuyu grass can smother young trees and compete for nutrients. Mulch around the base will minimise weed growth. However, removal of some weeds may be necessary.

Physical injuries: The natural bleeding of gum is sufficient to cover and heal small wounds. But large physical injuries may need application of anti-fungal sealants to prevent entry of water and bacteria.

Be wary of large lateral kauri roots if mowing lawns within the root-zone. Mulch can help prevent accidental mower damage.

Avoid securing wire or nails in the trunks of kauri. These activities cause damage over time.

3 HOW TO GROW KAURI

Growing kauri from seed can be achieved at home with a little care and planning.

Gathering seed

Great care needs to be taken to ensure seeds are taken from only healthy trees to ensure diseases such as kauri dieback are not spread. Cones can be collected from healthy trees when scales first start to appear on the forest floor (February–March).

This can be achieved by placing a raised plastic sheet below the canopy to catch the seeds as they fall. Alternatively, if there are two people available, a pair of long-handled loppers can be used to cut the cones from the tree with another person ready to catch the cones in a small net (e.g, swimming pool net).

Be sure to obtain permission before collecting seeds from public areas. These may potentially be affected by kauri dieback.

Cones placed in a dry room will naturally disintegrate within 5–10 days.

Viable seed needs to be separated out. Only seeds that are swollen at the base are viable (you should be able to feel a bump when squeezing the seed between thumb and forefinger).

Germination

Kauri seeds quickly lose viability over time, so should be planted as soon as possible after collection. Two seeds can be placed (wing up) in pots or bags of soil (5cm² x 8cm deep) and covered with a very thin layer of potting mix (just enough to cover the seeds). This provides enough space for one years' worth of growth. If both seeds germinate, the weaker plant should be removed.

Kauri cone shedding scales.

A warm environment (such as a glasshouse) and moist soil will enable seeds to germinate within two to three weeks. Around one month after germination, a two-leaved cotyledon should have emerged. Once this has reached about 5cm high, seedlings can be placed in a shade house or sheltered area outdoors to harden off.

At one year, seedlings will be 15–30cm in height and should be re-potted into a final container (PB3 bags should be adequate) to allow for growth of the developing root system. Care needs to be taken to prevent seedlings from becoming root-bound. Roots growing through holes in the bottom of the bag indicate a need for more room and the seedling will need re-potting. Do not cut

the roots as you will introduce injury points which could result in a pathway for infection. From two to four years old (about 40–60cm), seedlings can be successfully planted out (don't plant out if the seedling is less than 30cm in height).

Planting out and site preparation

For optimal growth, seedlings should be planted out in autumn (late March–April) while the soil temperature is still warm.

Site selection is critical when planting kauri. Think carefully about how large a kauri tree can grow before planting one in an urban environment. It could become a nuisance on a small suburban section, planted too close to a building or beneath an overhead obstruction like a power cable. Where trees have died due to kauri dieback disease, don't plant new kauri in or near the same area. Instead replant with other native species.

When planting out, place mulch (from a reputable source) or leaf litter at the base of the hole and position the seedlings so that one-quarter to one-third of the root ball is above ground level. Fill the hole and mound up with soil, mulch, and/or leaf litter around the remaining root ball. This procedure provides soft fertile material for the fine feeder roots to grow into.

Note that fertiliser should not be added into the hole before planting out as this can burn the roots.

Careful site selection and preparation is essential. The best results will be achieved by planting seedlings in moderately fertile, free-draining soil in sheltered sites with adequate space to grow.

With some work, seedlings can also grow well in less suitable conditions. Pre-pitting is a useful step in preparation of all soil types, especially for compacted or clay soil.

Pre-pitting involves digging a 30cm² pit one to three months before planting and placing the removed soil beside the hole to allow weathering. This process should develop a looser, lighter textured soil to place around the root ball. Mulch and

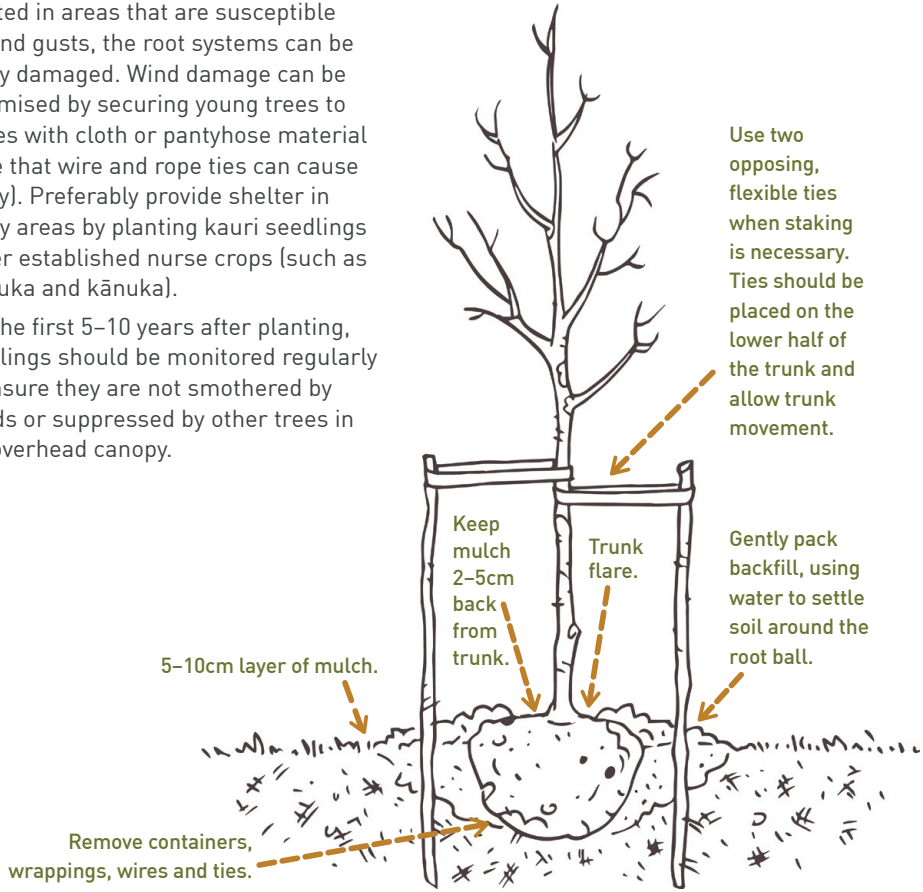
well decomposed compost can be added to the soil at this stage.

In areas with very hard soils (which prevent tap root development) or with waterlogged soils (which can lead to root rot), kauri can be planted on hand-made mounds of soil/mulch (1–1.5m in diameter and 0.5–1m high). Planting in mounds allows the root system to develop before encountering the harsher soil conditions below.

Kauri grow best in sheltered areas. If planted in areas that are susceptible to wind gusts, the root systems can be easily damaged. Wind damage can be minimised by securing young trees to stakes with cloth or pantyhose material (note that wire and rope ties can cause injury). Preferably provide shelter in windy areas by planting kauri seedlings under established nurse crops (such as mānuka and kānuka).

For the first 5–10 years after planting, seedlings should be monitored regularly to ensure they are not smothered by weeds or suppressed by other trees in the overhead canopy.

Like any native forest plant, individual kauri are part of a larger ecosystem. All members of the community are interconnected and are affected by one another. Care for kauri should first be based on care for the entire ecosystem/community in which it lives. Eradication of weeds and pest animal species will increase the health of the ecosystem, improving conditions for all plant species.



GLOSSARY

Araucariaceae – a family of conifer species.

Bleeding – deliberately injuring the trunks of kauri to cause gum production.

Branch abscission – ability of young kauri to drop branches without knots or scars developing.

Collar rot – damage to the tissues around the base of the trunk.

Conifer – cone–bearing plant.

Cotyledon – the first leaf of the embryo of a seed plant.

Damping off – root rot disease that can cause death of kauri seedlings.

Drip zone – the area of ground below the canopy of an individual tree.

Endemic – native or confined to a particular area.

Epicormic shoots – small shoots that grow from the lower trunk in response to sudden increase in light levels or stress.

Genera – plural of genus. A taxonomic category grouping closely related species.

Germinate – begin to sprout or grow.

Gummosis – gum production.

Humus – decomposed organic material.

Lianas – variety of climbing woody vines

Moko – facial tattoo.

Monoecious – plant species that produce male and female reproductive organs on the same plant.

Mycorrhizal fungi – fungi that have a beneficial relationship in and on the roots of host plants.

Nurse crop – plants that help establishment of kauri seedlings, mānuka and kānuka provide shelter for seedlings while allowing access to overhead light.

pH – a measure of acidity or alkalinity, on a scale from 0 (very acidic) to 14 (very alkaline). Neutral pH = 7.

Phytophthora – the phytophthora genus is a group of destructive plant pathogens. From Greek phyton, (plant) and phthora (destruction); "the plant destroyer".

Pre-pitting – weathering soil from planting hole prior to planting.

Rangatira – Māori chief or of noble birth.

Rootzone – area where roots grow horizontally. At least the area of the drip zone.

Rickers – the term "ricker" is a reference to either the sticks used to make a hay-rick; or as a corruption of "Riga" the Baltic port that had been a primary source of timber for British ship spars prior to development of the kauri timber industry.

REFERENCES AND FURTHER READING

Bergin, D & Stewart, G. (2004). *Kauri: Ecology, Establishment, Growth and Management.* New Zealand Forest Research Institute Limited.

Dwersteg, D. *Recreation of pristine kauri forest (Agathis australis) and present forest management in Northland, New Zealand.*

Ecroyd, C.E. (1982). *Biological flora of New Zealand 8. Agathis australis* (D. Don) Lindl.* (Araucariaceae) Kauri. *New Zealand Journal of Botany,* 1982, Vol. 20: 17-36.

Halkett, J & Sale, E.V. (1986). *The world of the Kauri.* Reed Methuen Publishers, Auckland.

Lloyd, R.C.(1977). *Planting Kauri: instructions and care.* New Zealand Forest Service.

Morrison, F.T & Lloyd, R.C. (1972). *Artificial establishment of New Zealand Kauri at Waipoua. New Zealand Journal of Forestry,* 17(2): 264–273.

Sando, C.T. (1936). Notes on *Agathis australis. Te Kura Ngahere,* 4(1): 16–21.

Silvester, W. B. (2006). *Managing Access to Heritage Kauri Trees.* Unpub.

Stewart, K. (2008). *Kauri.* Penguin Books Ltd, London.

Orwin, J. (2004). *Kauri: Witness to a nation's history.* New Holland Publishers, Auckland.

Waitakere City Council (2005). *Native to the West - a guide for planting and restoring the nature of Waitakere City.*

Department of Conservation (2001). *Protecting and restoring our natural heritage: A practical guide.*

WEBSITES

Kauri dieback: www.kauridieback.co.nz

Te Ara Encyclopaedia of New Zealand: www.teara.govt.nz

The Kauri Museum: www.kauri-museum.com

IMAGES

Cover: Te Matua Ngahere by Ronald Cometti. Courtesy of the Ronald Cometti Estate and Monmo Gallery, where the original artworks are exhibited and for sale.

Page 2: Te Matua Ngahere photograph, courtesy of Rebecca Stanley.

Page 3: Simulated comparison of Tāne Mahuta and Kairaru of Tutamoe by Barney Schwieters, 1982. Courtesy of The Kauri Museum.

Page 4: Historic photograph of felling of large kauri, courtesy of The Kauri Museum.

Page 6: Kauri cones, courtesy of Scion.

Page 8: Life stages of Kauri by Rozel Pharazyn, courtesy of Te Ara Encyclopaedia.

Page 10: Historic photograph of bleeding kauri, courtesy of The Kauri Museum.

Page 20: Pruning diagram, courtesy of Tāne's Tree Trust (Newsletter No. 13).

Page 21: Kauri cone shedding scales, courtesy of Scion.

Page 23: Tree planting diagram, adapted from www.treesaregood.org with permission from the International Society of Arboriculture.

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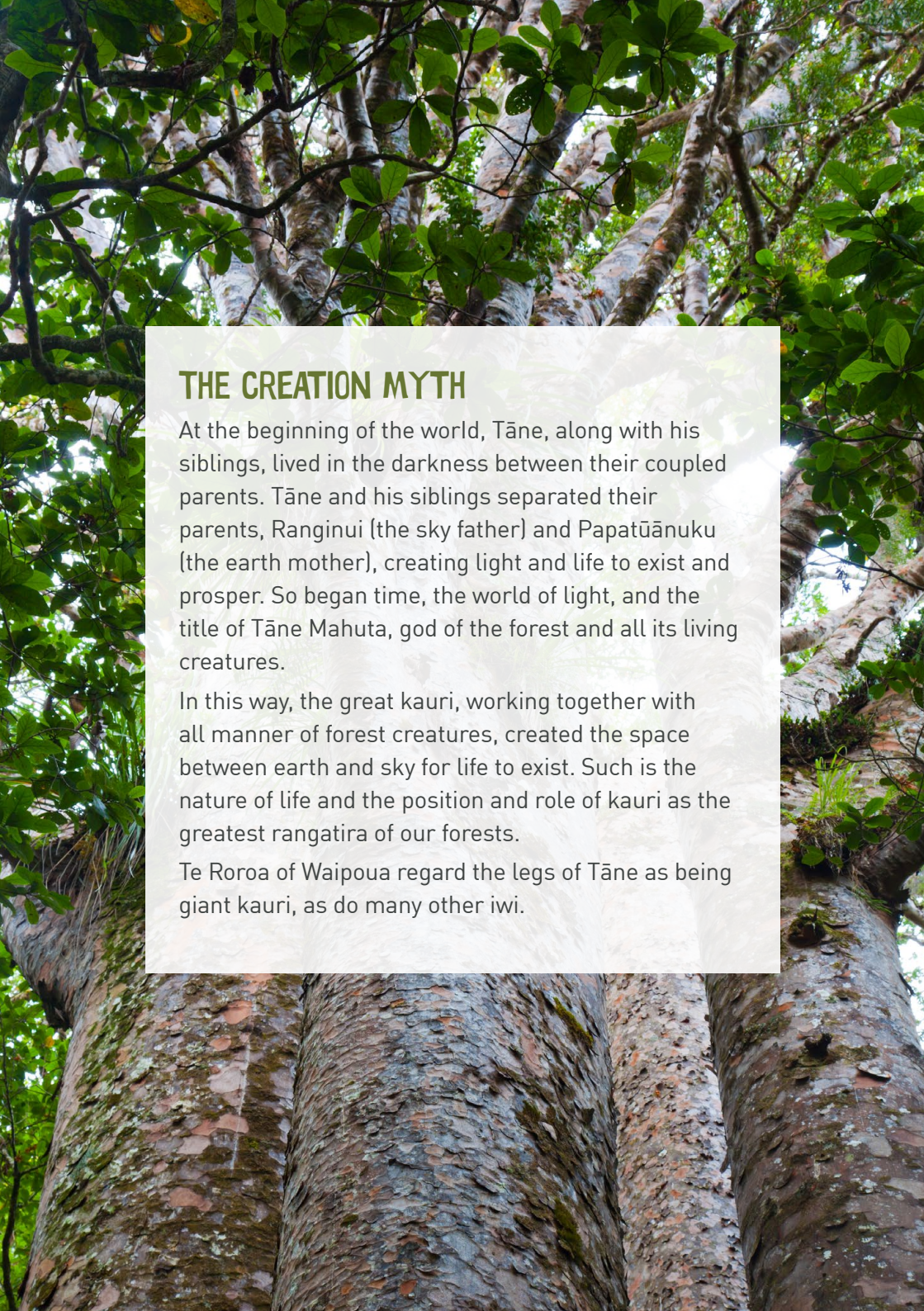

THE CREATION MYTH

At the beginning of the world, Tāne, along with his siblings, lived in the darkness between their coupled parents. Tāne and his siblings separated their parents, Ranginui (the sky father) and Papatūānuku (the earth mother), creating light and life to exist and prosper. So began time, the world of light, and the title of Tāne Mahuta, god of the forest and all its living creatures.

In this way, the great kauri, working together with all manner of forest creatures, created the space between earth and sky for life to exist. Such is the nature of life and the position and role of kauri as the greatest rangatira of our forests.

Te Roroa of Waipoua regard the legs of Tāne as being giant kauri, as do many other iwi.