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Wood properties and uses for indigenous tree species

In this summary we compare wood properties of different indigenous tree species. We used multiple sources to collate this information including our own archives. We have not cited all sources but provide a list of key references at the end of this document. It is possible there are further sources of knowledge and data, especially from indigenous knowledge holders. Scion makes no claim to the indigenous knowledge included in this brochure.

We have grouped the selected species into family classes. Table 1 shows wood properties from Podocarpaceae family of species. Table 2 shows Nothofagaceae family of species, and Table 3 shows selected other indigenous species. We have colour-coded them for high (green), medium (purple) or low (grey) for that property. The Podocarpaceae family of species contain some of our tallest and most iconic native species. However, there are some key differences in properties, uses and distribution for their natural growing range.

It is clear that, for some species, there remains gaps in knowledge and data. Scion will continue research into our lesser-known native species so that these gaps are filled, and these species can be used and products developed with confidence.

Kauri trunk

Wood properties

There is increasing interest from many landowners, including Māori, to diversify their forestry interests more widely than radiata pine plantations. For native species, the availibility of wood property data has been scarce. For some species, historic or traditional knowledge is sometimes lost or hidden away. Wood properties like mechanical properties, shrinkage metrics and durability classes are important for those wishing to realise multiple benefits from native trees including carbon and timber.

Table 1: Wood properties for a range of species from the Podocarpaceae family

Species	Density (kg/m3) [a]	Tangential Shrinkage (%)	Radial Shrinkage (%)	Drying requirements	Strength (MOR, MPa)	Stiffness (MOE, GPa)	Hardness (kN)	Durability (years) [b]
Tōtara	Medium: 400-600	5-10	<3	Air-dry-Kiln	<75	8-10	<4	15-25
Kahikatea	Medium: 400-600	<5	<3	Kiln-dry	<75	10-12	<4	<5
Rimu	Medium: 400-600	<5	3-5	Kiln-dry	75-125	10-12	<4	5-10
Tānekaha	High: > 600	<5	3-5	Air-dry	75-125	12-14	4-8	5-10
Miro	Medium: 400-600	5-10	<3	Kiln-dry	75-125	12-14	<4	5-10
Mātai	High: > 600	<5	<3	Kiln-dry	75-125	10-12	<4	5-10

Notes:

[a] Density measurements are given at 12% moisture content.

[b] Durability class is given as the rating for the heartwood only. Sapwood is not durable in outdoor situations. Durability classes are based on in-ground performance and may perform for longer in above ground situations.

The beeches of Aotearoa New Zealand (Nothofagaceae) grow largely in the southern areas, and some species in this family have beautiful timber. The New Zealand beech is a completely different family to the European beech (Fagaceae). The trees have a tendency to hybridise with each other, making species identification sometimes difficult. Some of these species have challenges in processing and drying.

Table 2: Wood properties for a range of species from the Nothofagaceae family

Species	Density (kg/m³) [a]	Tangential Shrinkage (%)	Radial Shrinkage (%)	Drying require-ments	Strength (MOR, MPa)	Stiffness (MOE, GPa)	Hardness (kN)	Durability (years) [b]
Hard beech	High >600	5-10	<3	Air-dry-Kiln	75-125	12-14	4-8	15-25
Mountain beech	High >600	5-10	<3	Air-dry-Kiln	75-125	12-14	4-8	15-25
Red beech	High >600	5-10	<3	Air-dry-Kiln	75-125	10-12	4-8	15-25
Silver beech	Medium: 400-600	5-10	<3	Kiln-dry	75-125	10-12	4-8	5-10

Notes:

[a] Density measurements are given at 12% moisture content.

[b] Durability class is given as the rating for in-ground performance for heartwood only. Sapwood is not durable in outdoor situations. Durability classes are based on in-ground performance and may perform for longer in above ground situations.

There are many indigenous species that have a wide range of different uses and are valuable traditionally and historically but might have been overlooked for contemporary uses. This final table has a range of selected species that don't fit in into the above families that might be of interest. We do hold some data on other species, so make a request if you are interested in properties of species not shown here.

Table 3: Wood properties for selected other indigenous species

Species	Density (kg/m³) [a]	Tangential Shrinkage (%)	Radial Shrinkage (%)	Drying requirements	Strength (MOR, MPa)	Stiffness (MOE, GPa)	Hardness (kN)	Durability (years) [b]
Kauri	Medium: 400-600	<5	<3	Kiln-dry	75-125	10-12	<4	5-10
Rewarewa	High >600	>10	3-5	Air-dry	75-125	12-14	4-8	Unknown
Tawa	High >600	5-10	3-5	Kiln-dry	75-125	12-14	4-8	<5
Kōwhai	High >600	Unknown	Unknown	Unknown	125-150	12-14	>8	15-25
Pūriri	High >600	Unknown	Unknown	Unknown	Unknown	12-14	Unknown	15-25
Houhere	High >600	Unknown	Unknown	Unknown	Unknown	12-14	Unknown	Unknown
Mangeao	Medium: 400-600	Unknown	Unknown	Unknown	75-125	8-10	4-8	Unknown
Black maire	High >600	5-10	>5	Air-dry	75-125	12-14	Unknown	Untested [c]

Notes:

[a] Density measurements are given at 12% moisture content.

[b] Durability class is given as the rating for the heartwood only. Sapwood is not durable in outdoor situations. Durability classes are based on in-ground performance and may perform for longer in above ground situations.

[c] Heartwood of this species is thought to be durable but no tests have been conducted.

Uses and qualities of interest

We have drawn on a wide range of knowledge including historic research reports, published articles, websites and mātauranga Māori for the historic, contemporary and traditional uses. We have included some general qualities of interest such as ease of propagation and machining, with comments on potential for rongoa and other miscellaneous information gathered. Tables 4-6 show the equivalent three tables for uses and other qualities of interest.

Carving Tōtara

Table 4: Uses and qualities of interest for a range of species from the Podocarpaceae family

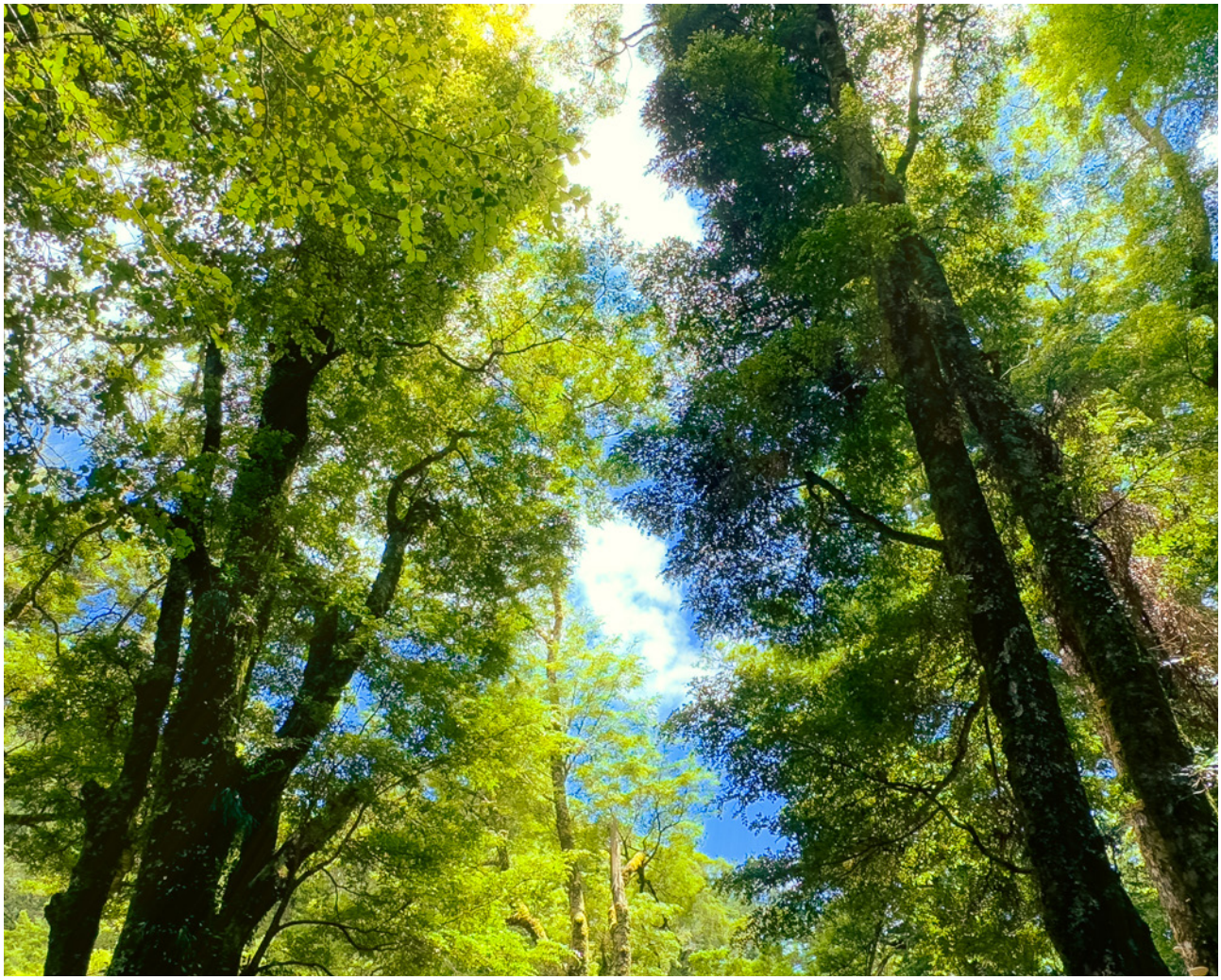
Species	Timber	Carving/ Whakairo	Carbon	Food (people)	Extracts	Qualities of Interest	Birds - Honey	Comments
Tōtara	High	Very high (preferred species)	High	Yes (berries)	High	Easy to grow from seed, machines well	Yes (birds) No (honey)	Smoke from burning wood potential for rongoa
Kahikatea	High (interior) High with treatment (exterior)	Medium	High	Yes (berries)	High	Grows readily from seed, machines well into long clear boards.	Yes (birds) No (honey)	Potential for rongoa
Rimu	High	Medium (instruments)	High	Yes (seeds, leaves)	High	More difficult to propagate & establish; paints well, excellent machining properties	Yes (birds) No (honey)	Strong for several Rongoa Torches made from heartwood Can be pulped
Tānekaha	High	High (weapons, waka)	Unknown	Unknown	High	Propagation by seed is difficult Strongest, most flexible softwood in NZ	Unknown	Strong for several Rongoa (bark, leaves)
Miro	High	Unknown	Unknown	Yes (berries)	High	Propagation by seed or cuttings.	Yes (birds) No (honey)	Several Rongoa (bark, berries) Antiseptic and insecticide uses
Mātai	High	High (waka, instruments)	High	Yes (sap, berries)	High	Grown from seed but germination can be long (up to 3 years) Very slow growing	Yes (birds) No (honey)	Potential for rongoa

Note: Rating used is high, medium or low suitability for this use.

Table 5: Uses and qualities of interest for a range of species from the Nothofagaceae family

Species	Timber	Carving/ Whakairo	Carbon	Food (people)	Extracts	Qualities of Interest	Birds - Honey	Comments
Hard beech	High	Very high (preferred species)	High	No	High (heartwood)	Easy to grow from seed, machines well	No	Smoke from burning wood potential for rongoa
Mountain beech	Medium (interior)	Unknown	High	No	High (heartwood)	Silica content is disincentive to sawmillers.	No	Interior articles such as broom handles. Suitable for chemical pulping, unbleached kraft yield <45%.
Red beech	High	Unknown	High	No	High (heartwood)	Propagation is easy from seed which must be sown fresh. Difficult to dry without degrade	No	Less tension wood than hard beech, but nearly as dense.
Silver beech	Medium (interior)	Unknown	High	No	High (heartwood)	Very few woods match silver beech for evenness of texture in all directions.	No	Suitable for chemical pulping, unbleached kraft yield <45%

Note: Rating used is high, medium or low suitability for this use.



Beech forest

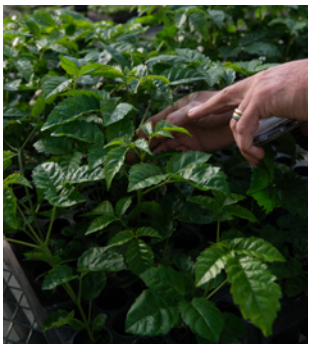
Silver and red beech trunks

Table 6: Uses and qualities of interest for selected other indigenous species

Species	Timber	Carving/ Whakairo	Carbon	Food (people)	Extracts	Qualities of Interest	Birds-Honey	Comments
Kauri	High	High (waka, tools)	Unknown	Some (gum)	High	Propagation by seed which remain viable for a short time (unless stored in freezer)	No	Kauri gum used in torches, varnish or ornaments.
Rewarewa	Low (craft/ decorative only)	Unknown	High	No	High	Bark used as wound dressing. Charcoal used in the construction of waka	Yes (honey)	Timber instable in service. Difficult to burn.
Tawa	High	High (waka paddles, tools)	High	Yes (fruit, kernel, bark)	Medium	Seeds germinate readily. Best species in NZ for turning across the grain	Yes (birds) Some (honey)	Wood burns when green, low MC when cut.
Mānuka	Low	Low	Medium	No	High	Easy to propagate at scale	No (birds) Yes (honey)	Rongoa
Kōwhai	High	Unknown	Unknown	No	High	Propagated by fresh seeds and cuttings. Wood dense but log of small dimensions	Unknown	Rongoa
Pūriri	High	Low (canoe paddles)	Unknown	Unknown	High	Propagation can be achieved by seed or cuttings Timber is hard, strong, stable and durable.	Unknown	Rongoa (leaves)
Houhere	Low	Low	Unknown	No	Unknown	Unknown	No (birds Yes (honey)	Rongoa and raranga (weaving)
Mangeao	High	Medium (waka when preferred species NA)	Unknown	Unknown	Unknown	Potential for silviculture management, possibly valuable for decorative purposes	Unknown	Rongoa (vapour baths)
Black maire	High	High (waka paddles, bailers, beaters and tools)	High	No	Medium	Excellent as a metal substitute for bearings and machinery framing. Propagation is easiest from seed (needs 20 w stratification)	Yes (birds) Some (honey)	Timber is hard, heavy, strong, durable. Popular for firewood, burns slowly, great heat output, without sparking.

Note: Rating used is high, medium or low suitability for this use.

Tōtara wood planks



Pūriri propogation

Kōwhai seedling

Mānuka flower

Tree and growing characteristics

There are other more detailed reports and sources for information on our indigenous tree species and their growing characteristics. We have collated here some basic facts on where these species naturally grow, how large and the growth rate.

Table 7: Tree and growing characteristics for a range of species from the Podocarpaceae family

Species	Latin name	Distribution – North Island	Distribution – South Island	Tree size	Growth rates (cm/year)	Comments
Tōtara	*Podocarpus totara*	Widespread	Widespread	Tall 20-30 m	51-74	Growth up to 50-60 m
Kahikatea	*Dacrycarpus dacrydioides*	Widespread	Widespread	Tall 20-30 m	51-74	Growth up to 60-80 m
Rimu	*Dacrydium cupressinum*	Locally common	Locally common	Tall 20-30 m	<25	Growth up to 80 m
Tānekaha	*Phyllocladus trichomanoides (Phyllocladus rhomboidalis)*	Widespread	Locally common	Tall 20-30 m	<25	
Miro	*Prumnopitys ferruginea (Podocarpus ferruginea)*	Widespread	Widespread	Tall 20-30 m	<25	
Mātai	*Prumnopitys taxifolia (Podocarpus spicatus)*	Widespread	Widespread	Tall 20-30 m	<25	

Table 8: Tree and growing characteristics for a range of species from the Nothofagaceae family

Species	Latin name	Distribution – North Island	Distribution – South Island	Tree size	Growth rates (cm/year)	Comments
Hard beech (tāwai raunui)	*Fuscopora truncata*	Locally common	Widespread	Tall 20-30 m	51-74	Growth up to 50-60 m
Mountain beech (tāwai rauriki)	*Fuscopora cliffortioides*	Locally common	Widespread	Tall 20-30 m	51-74	Growth up to 50-60 m
Red beech (tāwai raunui)	*Fuscopora fusca*	Locally common	Widespread	Tall 20-30 m	51-74	Growth up to 50-60 m
Silver beech (tāwhai/tāwai)	*Lophozonia menziesii*	Locally common	Widespread	Tall 20-30 m	25-50	Growth up to 100 m

Table 9: Tree and growing characteristics for selected other indigenous species

Species	Latin name	Distribution – North Island	Distribution – South Island	Tree size	Growth rates (cm/year)	Comments
Kauri	*Agathis australis*	Locally common	Locally common	Tall 20-30 m	25-50	Growth up to 50-60 m
Rewarewa	*Knightia excelsa*	Widespread	Locally common	Tall 20-30 m	25-50	Growth up to 80 m
Tawa	*Beilschmiedia tawa*	Widespread	Locally common	Tall 20-30 m	<25	Growth up to 200 m
Mānuka	*Leptospermum scoparium*	Widespread	Widespread	Small 10-15 m	>75	Growth mostly 2-5 m
Kōwhai	*Sophora microphylla*	Widespread	Widespread	Small 10-15 m	Unknown	
Pūriri	*Vitex lucens*	Widespread	Uncommon	Medium 15-20 m	>75	Growth up to 50 m
Houhere	*Hoheria sexstylosa*	Widespread	Locally common	Small 10-15 m	>75	
Mangeao	*Litsea calicaris*	Locally common	Unknown	Small 10-15 m	25-50	
Black maire	*Nestegis cunninghamii*	Uncommon	Uncommon	Medium 15-20 m	<25	

Key references

Bayne, K. M., Holt, L. J., Yao, R. T., & Firm, D. (2019). Scoping alternative uses for trees in Northland region. Scion.

Cambie, R. C. (1976) A New Zealand Phytochemical Register — Part III., Journal of the Royal Society of New Zealand, 6:3, 307-379.

Clifton, N. C. (1990). New Zealand timbers exotic and indigenous the complete guide. Wright & Carman Ltd.

Crowe, A. (2004). A field guide to native edible plants of New Zealand. Penguin NZ.

Easdale, T., Allen, R. B., Burrows, L. E., Henley, D. G., & Franklin, D. (2022). More timber from fewer trees – determining what tree density optimises silver beech merchantable yield based upon a long-term thinning trial. New Zealand Journal of Forestry Science, 52.

Indigenous forest review paper / Alternate and indigenous forest species research questions spreadsheet 2014 - Scion sourced paper.

Jones, T. G. (2005) Wood properties of New Zealand commercial tree species. NZIF Forestry Handbook Section 9.1 - Utilisation of forest products. The New Zealand Institute of Forestry. 4th Edition. p. 204-208.

Kirk, T. (1889). The forest flora of New Zealand. Wellington, Government Printer. The forest flora of New Zealand / by T. Kirk. - National Library of New Zealand Catalogue.

KPMG (2013). Indicative value analysis of New Zealand's privately owned indigenous forests. MPI report. p. 39.

Mortimer, J & B. (1984). Trees for the New Zealand countryside: a planter's guide. Silverfish, Auckland.

Pardy, G. F., & Bergin, D. (1988). Growth of native trees in plantations. What's New in Forest Research; No. 173.

Pardy, G. F., Bergin, D., & Kimberley, M. (1990). Survey of native tree plantations. (Forest Research Institute Bulletin; Vol. 175).

Steward, G. A. (2019). To the heart of the matter – heartwood content in tōtara. New Zealand Journal of Forestry, 64(2), 37-41.

Steward, G., McKinley, R. (2019). Indigenous plantation - implications for wood quality. NZ Journal of Forestry, 64(2), pg 44-47.

Tane's Tree Trust species profiles: https://www.tanestrees.org.nz/species-profile.

Wardle, J. (2011).Wardle's native trees of New Zealand and their story. Bateson Publishing Limited.

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