New Zealand manuka (*Leptospermum scoparium*; Myrtaceae): a brief account of its natural history and human perceptions

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Introduction

Leptospermum scoparium J.R.Forst. & G.Forst. (Myrtaceae) is commonly known in New Zealand as manuka or tea tree (Fig. 1 A–C).

Fig. 1 *Leptospermum scoparium* (manuka). **A,** plant growing as a tall shrub in regenerating bush. Photo: Roy Edwards. **B,** white flower typical of most wild forms. Photo: Trevor James. **C,** capsules that contain numerous seeds. Photo: Trevor James.

It is a native shrub or small tree of variable height (ranging from a prostrate growth form up to a 4–8 m tall tree) and varies greatly in size according to the individual plants' particular habitat (Thompson, 1989). A number of botanical varieties have been proposed (Allan, 1961), and a review of the species was recently carried out by Stephens et al. (2005).

No other plant species in the New Zealand flora seems to have faced more contradictory values. Although manuka plays an important role in New Zealand ecosystems, it was deemed a weed for many decades and was treated as such. Manuka has more recently been recognized as a plant of increasing importance, both ecologically and economically (Anon, 2004; Stephens et al., 2005).

Geographical distribution, habitat and ecological importance in New Zealand

Leptospermum scoparium may not be endemic to New Zealand – in her taxonomic revision, Joy Thompson (1989) also considered it to be native to south-east Australian regions, including Tasmania, from where it seems to have originated[2]. Thompson (1989) suggested that when *L. scoparium* arrived in New Zealand it was confined to limited areas with particular soil characteristics. Manuka seems to have thrived in habitats that were extreme in some way, and marginal for the growth of woody plants (Burrows, 1973). In New Zealand, its apparently restricted distribution prior to human settlement has since expanded (Cockayne, 1928; Bellingham, 1956). Humans brought fires and cleared two thirds of the original forest cover (Cockayne, 1928; Burrows, 1973), creating many areas with low-nutrient status suitable for *L. scoparium* (Harris et al., 1992). Disturbance processes such as nutrient leaching, repeated fires and soil erosion helped maintain *L. scoparium* cover in many areas where the plant community would eventually return to forest (Burrows, 1973).

Manuka is likely to be the most widespread, abundant and environmentally-tolerant woody species in New Zealand (Ronghua et al., 1984). It is found from Cape Reinga to Stewart Island, from sea level to above the treeline (Cockayne, 1928; Scott, 1977; Ronghua et al., 1984) as high as c.1600 m (Esler and Astridge, 1974). It can tolerate soils with low fertility, high acidity, low or high moisture contents; it is able to withstand wind-exposed sites and salt sprays (Burrell, 1965; Burrows, 1973). It is also tolerant of harsh environments, including ultramafic sites that are high in nickel and chromium (Connor, 1985). Manuka is also commonly found in waterlogged sites, from lowland to montane bogs or pakihis in north-west Nelson and Westland (Cook et al., 1980). Johnson (1972) studied the lakeshore vegetation around Lakes Manapouri and Te Anau, and suggested that manuka's root system is able to tolerate continuous flooding of up to 272 days.

The species' life-history strategy is that of an '*r*-type' plant, adapted for dispersal, colonisation and rapid population growth (Ogden, 1985). Its typical characteristics as a pioneer species include short life cycle, rapid growth rates, relatively short stature, wide ecological amplitude, great seed production and high light demands (Ogden, 1985; Mark et al., 1989). Manuka is ecologically important in the New Zealand environment and

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[2] Australian plants are much less variable than the range seen in New Zealand.

is a key species in the early stages of succession following large-scale disturbance in many New Zealand forests, where it can act as a 'nurse' crop (Ogden and Stewart, 1995). Manuka plays this role in kauri forests in northern New Zealand (Ogden and Stewart, 1995), dense podocarp forests in central North Island (Cameron, 1955; McKelvey, 1963) and in montane rain forests in Fiordland (Mark et al., 1989). In beech forests the ectomycorrhizas of manuka seem to assist in the process of seedling establishment (Burrows and Lord, 1993).

Manuka: the weed

Although it is a native plant, manuka was perceived as a noxious weed of farmland for a large part of the 1900s, and indeed, it is still listed in the current edition of *Common Weeds of New Zealand* (Fig. 2; Roy et al., 2004). Its eradication was a widespread goal because the species was seen as a major impediment for development of the hill country (Bates, 1940; Hamblyn, 1948; Madden, 1951; Roberts, 1957; Small, 1961; Marshall, 1962). Bates (1940) for instance, complained that the control of manuka "is often very difficult and uneconomic because of high maintenance costs per acre in the incessant struggle against this persistent weed". Supporting such views, publications like *Sheepfarming Annual* and the *New Zealand Journal of Agriculture* published numerous articles providing advice for farmers on how to clear manuka from hill country.

Fig. 2 *Leptospermum scoparium* growing as a 'weed' in pastureland. Photo: Trevor James.

It was under such a scenario that manuka blight was first observed in New Zealand, in the remote areas of Canterbury in 1937 (Hoy, 1954a; Roberts, 1957; van Epenhuijsen et al., 2000). The introduced scale insect *Eriococcus orariensis* Hoy (Hemiptera: Eriococcidae) was found to be the culprit, and the associated black sooty mould fungus invariably grows on the insect's honeydew (Hoy, 1949, 1954b). Infestation by both insect and fungus was colloquially known as 'manuka blight' (van Epenhuijsen et al., 2000). In the first decades of its spread, there was widespread mortality of *L. scoparium* (Hoy, 1949, Hoy, 1954a; Roberts, 1957).

The impact of manuka blight on the species was extensive. This surprised scientists from the former DSIR, who suggested that manuka blight was the most efficient biological control of a plant ever seen in New Zealand (Hoy, 1954a). As a result, the use of manuka blight as a biological control was widely adopted (Hoy, 1949, 1954a, 1954b; Madden, 1951; Roberts, 1957), and infected manuka were sold so that it could be purposefully spread (Sewell, 1953). Many celebrated the arrival of the disease as a possible solution for the "manuka problem" (Madden, 1951; Roberts, 1957).

The farming community's feelings for the plant were evident. Marshall (1962) for instance, proudly described the "development" of a 4,700 acre property from manuka to grass. Providing maps of the "infestation" of manuka he outlined all the techniques used to eliminate the "weed", such as spraying, burning and cutting. Small (1961) described manuka as "the arch-criminal weed of hill pastures", and complained of "its impact on the national economy", stating that "every plant must be destroyed together with its seed" in order to develop the "weed-infested hill country". Despite a general dislike of manuka among farmers, some acknowledged the potential environmental consequences from the attempts to exterminate *L. scoparium* from the landscape. Madden (1951) for instance, pointed out the risk of soil erosion, and Roberts (1957) noticed the infestation by more undesirable plants and weeds.

Despite the anti-manuka campaign and the intentional spread of manuka blight, *L. scoparium* has managed to overcome the effects of the pathogen and achieved a remarkable comeback. It seems that the range and abundance of the original manuka blight scale insect (*Eriococcus orariensis*) have been steadily reduced by a parasitic fungus, being consequently displaced in recent years by the less noxious scale insect *E. leptospermi* (van Epenhuijsen et al., 2000). Manuka blight now only seems to affect *L. scoparium* to a moderate degree, causing some branches and individual plants to die (Burrows and Lord, 1993). The black sooty mould fungus remains an unsightly problem on the ornamental cultivars, which still benefit from periodic spraying of winter oil for control (Murray Dawson, pers. comm. 2008). However, manuka blight now appears to have little effect on the natural distribution of *L. scoparium* populations in the wild.

Manuka: the invaluable plant

The negative image of manuka started to change in the 1970s and 1980s. Williams (1981) recognized that the hill country was undergoing rapid development for agriculture and forestry, and compiled a bibliography of articles on manuka and the morphologically similar kanuka (*Kunzea ericoides* (A.Rich.) Joy Thomps.; also of the Myrtaceae family). He stressed the importance of considering "the value of existing vegetation for soil and water conservation, biological conservation and aesthetics". Though manuka is still occasionally used as firewood it is also valued for its ethnobotanical and ornamental use, as well as a source of essential oils and honey (Stephens et al., 2005).

Maori used manuka wood for timber and for the manufacture of weapons and tools for agriculture (Patel, 1994). The leaves, bark and 'gum' were used for a variety of medicinal purposes, with leaf decoctions used to reduce fever and treat colds, and bark preparations used as sedatives (Salmon, 1980; Brooker et al., 1987). Manuka oil was also used in traditional medicine for treating diarrhoea, colds and inflammation (Lis-Balchin and Hart, 1998). Early European settlers appear to

have taken a strong like to its leaf decoctions as well (Stephens et al., 2005). The common name 'tea tree' was apparently given by Captain Cook, as a tea substitute was made from manuka leaves by Cook's men and the early settlers (Salmon, 1980). European settlers also used manuka as firewood, for fencing and in the manufacture of tool handles (Salmon, 1980).

Fig. 3 *Leptospermum scoparium* 'Red Damask', a popular double-flowered garden cultivar. Photo: Roy Edwards.

Leptospermum scoparium is also valued as a plant of ornamental qualities (Fig. 3), being extensively cultivated in New Zealand and Europe (Stephens et al., 2005). Manuka is widely used in horticulture with more than 70 cultivars varying greatly in size, colour (of floral and vegetative features) and shape (Bicknell, 1995; Dawson, 1990, 1997a, 1997b). It has an ideal form for a cut flower, but its use is limited by a short vase life (Bicknell, 1995; Burge et al., 1996).

Considerable interest has arisen in the potential uses of the essential oils distilled from manuka leaves (Stephens et al., 2005) which may be of economic importance (Harris et al., 1992). Studies on the potential medical applications of manuka oils have also been undertaken, particularly as an antibacterial (e.g., Weston et al., 1999). Reichling et al. (2005) examined the inhibitory activity of manuka oil against *Herpes simplex* viruses, obtaining positive results. A pharmacological study suggested its use as a relaxant is likely to be valid (Lis-Balchin and Hart, 1998). *Leptospermum scoparium* oils also contain chemical compounds with antihelminthic (drugs that expel or destroy parasitic intestinal worms) and insecticidal properties (Brooker et al., 1987; Lis-Balchin et al., 2000), and were also shown to have antioxidant, antibacterial and antifungal properties (Lis-Balchin et al., 2000).

The honey obtained from manuka (Fig. 4) is considered to be of high quality, having a relatively unique taste. Stephens et al. (2005) described it as having "a distinctive flavour, colour, and consistency and until recently was used solely for culinary purposes". Manuka honey is also highly sought after for its medicinal properties. It was shown to have antibacterial effect against *Helicobacter pylori* (Somal et al., 1994), *Escherichia coli* (Mavric et al., 2008), *Staphylococcus aureus* (Allen et al., 1991; Mavric et al., 2008), methicillin-resistant *S. aureus*, and a number of vancomycin-resistant and -sensitive *Enterococcus* strains (Cooper et al., 2002).

Fig. 4 Manuka honey being promoted for its medicinal properties. Photo: Airborne Honey Ltd.

It is worth highlighting here the dramatic change in perceptions that have occurred during the past 40 years. Madden (1951) discussing the arguments in favour of spreading manuka blight, stated that "an inferior grade of honey is obtained from manuka, but if manuka were replaced with grass and clover a better quality honey might be produced".

Conclusion

The changing human perspective on manuka during the past century illustrates how the term 'weed' is an anthropocentric label based on the paradigms of a particular locality and/or time. For manuka, the generally accepted view has fortunately transformed from that of a 'persistent weed' to a rather more positive evaluation. It is now recognized not only as ecologically important, but also as a natural resource of economical, ornamental and medicinal value.

It is also important to recognise *L. scoparium* as a species of conservation significance. Manuka is a rather remarkable species, with an incredibly wide tolerance to a range of environmental conditions, and is a key plant in many New Zealand ecosystems. Like many (if not most) native shrub species in New Zealand, manuka remains neglected in our conservation network. As Ronghua et al. (1984) pleaded, *L. scoparium* communities should be adequately represented in the New Zealand reserves system.

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