

3 Creating Gardens: The Diversity and Progression of European Plant Introductions

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3.1 Introduction

New Zealand lacked large land mammals and consequently the native flora evolved without the evolutionary pressures conducive to the development of mammal-browse-tolerant foliage and, importantly for humans, large edible fruit. Neither does the native seed plant flora include species with large edible underground food reserves, apart from bracken (*Pteridium esculentum*) and ti (*Cordyline australis*). Maori came less than 1,000 years ago from the tropics, where they did not have temperate food or agricultural plants capable of growing throughout New Zealand, although they did successfully introduce taro (*Colocasia esculenta*), kumara (*Ipomoea batatas*), yam (*Dioscorea alata*), and Pacific Island cabbage tree (*Cordyline fruticosa*) to warmer areas. Thus, to obtain plants for purely utilitarian and commercial purposes, with the notable exceptions of timber and flax (*Phormium*), European civilization was forced to import on a large scale. Like colonists everywhere, they also brought nostalgic reminders of home. Color was especially important because few New Zealand plants have conspicuous flowers, and even these are mostly white. The colonists had the advantage of being in a temperate environment, however, and in 200 years, more than 25,000 species of plants were introduced. Of these, about 2,200 now grow wild, many in restricted habitats, and others from the coast to the alpine zone. Almost half of the plant species came from Europe, this proportion increasing to three-quarters if North Africa and temperate Asia are included, and the remainder from all corners of the earth. This chapter tells the story of their arrival and escape.

3.2 The Chroniclers

The documentation of this story has been sporadic. Naturalized plants were first mentioned by Banks (in Beaglehole 1962) and Darwin (1859), but the first systematic account is by J.D. Hooker (1867) who recorded 170 naturalized species. (All records have been standardized to present-day naturalized status). Many of these were from Auckland, collected by T. Kirk, who in a later account of this area (Kirk 1870) listed 257 naturalized species. Cheeseman's (1925) *Manual of the New Zealand flora* recorded 567 naturalized species, and Thomson (1922) in a study of naturalizations considered over 600 species could be regarded as "more or less" naturalized. (Here, we use the terms "fully naturalized" for species forming self-sustaining populations in the wild, and "casuals" for those that have not yet established but have been recorded occasionally. "Naturalized" we use to cover both sub-groups). Despite the publication of Allan's *Handbook of the naturalized flora of New Zealand*, the recorded number had not risen above 441 fully naturalized species, and 347 of minor or doubtful occurrence 18 years later (Allan 1940). A.J. Healy and others subsequently made many individual records; Healy and Edgar (1980) listed 168 naturalized monocotyledons (excluding grasses). With the publication of the naturalized pteridophytes, gymnosperms, and dicotyledons, a total of 1,470 species or "species equivalents" were recorded (Webb et al. 1988). The grass flora (Edgar and Connor 2000) added a further 226 species, to make naturalized 2,108 seed plants and gymnosperms (Wilton and Breitweiser 2000). Additional records since then bring the total naturalized flora of seed plants and ferns to 2,166 species, which include 23 naturalized pteridophytes. Discounting the few introduced by Maori (<10 spp. suspected), this equates to one new species every 39 days since Capt. James Cook first sighted land in 1769.

This naturalized flora added 65 families, with at least one fully naturalized species, to the total flora of New Zealand. The largest of these are Salicaceae (25 spp.), Pinaceae (18 spp.), Amaranthaceae (14 spp.), and Papavaceae (11 spp.). The largest naturalized genera containing no indigenous species are *Trifolium*, *Salix*, *Veronica*, and *Rosa*. Many new families comprise plant life-forms similar to the indigenous flora whereas others added new elements to the landscape, e.g., arum lilies (*Zantedeschia aethiopica*), and wild gingers (*Hedychium* spp.). Novelty aside, genera with native congeners have the highest naturalization rates (Duncan and Williams 2002a, b).

3.3 Plant Introductions and Their Escape

3.3.1 Early European Settlers and Farming

Plants were brought to New Zealand via many pathways, for pleasure, profit, and/or utility. The first successful European introduction was the tuberous potato (*Solanum tuberosum*), which was selected for subsistence, similarly to the kumara 800 years earlier by Maori. James Cook visited Marlborough Sounds in 1770, and introduced potatoes along with turnips (*Brassica rapa*), carrots (*Daucus carota*), and parsnips (*Pastinaca sativa*). Maori subsequently neglected the gardens, but they were familiar with root crops and the potatoes were still there on Cook's third voyage in 1777, and have remained in the area, probably continuously, ever since (Clark 1949). Wild cabbage (*Brassica oleracea*) was gathered from these gardens in 1820 (Clark 1949), and possibly represents the first cultivation escape – or perhaps this was wild onion (*Allium vineale*), reputedly wild before 1800 in the Bay of Islands from French plantings in 1772 (Thomson 1922). Vegetable gardens were well established by 1820 at various points, from Foveaux Strait in the south, to the Bay of Islands in the north. Here the missionaries, who introduced the first plough at Kerikeri in the same year, encouraged gardening. From the 1840s onward, gardening intensified at several localities throughout New Zealand, the resulting disturbance increasing the opportunities for plant naturalizations.

Potatoes were initially used to assist breaking in the ground for grains, especially on cutover forestland. Wheat became the main dietary starch source by the 1850s when the growing European population began searching for pasture for sheep and cattle. Native plant species provided little in this respect away from the South Island uplands. In Auckland, cattle were pushed into native scrub and forest (Esler 1988). Introduced grasses and herbs were sown on land cleared from forest or fern. Browntop (*Agrostis capillaris*), danthonias (*Rytidosperma* spp., from Australia), sweet vernal (*Anthoxanthum odoratum*) and suckling clover (*Trifolium dubium*) were important. Arable land required a wider range of grasses, and by 1870 in Auckland these included perennial ryegrass (*Lolium perenne*), Italian ryegrass (*Lolium multiflorum*), bluegrass (*Poa pratensis*) and several other clover species. Herbs considered necessary for animal health, but now thought of as pasture weeds, were also sown, e.g., narrow-leaved plantain (*Plantago lanceolata*) and yarrow (*Achillea millefolium*). Scotch thistles (*Cirsium vulgare*), which arrived accidentally, were initially protected by Scottish immigrants for nostalgic reasons (Thomson 1922), soon supplanted by annoyance as their crops and pastures became infested.

These farms and habitations required protection, and exotic hedges and shelterbelts introduced by the very early colonists provide spectacular examples of invasion sources. Gorse (*Ulex europaeus*) was planted as a fence atop drainage excavations in Canterbury, from where it spread irrepressibly within

30 years. Broom (*Cytisus scoparius*) was also used as stock food. Initially less invasive than gorse, primarily because of its palatability to stock, broom is now spreading rapidly in both main islands. On the North Island, shelter was provided by several *Acacia* spp., hawthorn (*Crataegus monogyna*), and *Hakea* spp. from Australia. All these are now major weeds in parts of the country. Monkey apple (*Acmena smithii*) is used as a shelter for horticulture crops in northern parts where it is now invading intact forest. Pampas grasses (*Cortaderia* spp.) were also introduced for shelter, and cattle fodder – their legacy a major weed problem of exotic plantation forests, and for biodiversity conservation in open areas such as sand dunes.

Horticulture has been a major pathway contributing to the naturalized flora. A variety of fruits were grown by the 1840s in northern New Zealand, and the superiority of this warm-temperate region for woody plants and vines with edible fruits persists. Cape gooseberry (*Physalis peruviana*) had escaped by 1843, followed by blackberry (*Rubus fruticosus* complex), sour cherry (*Prunus cerasus*), wild peaches (*Prunus persica*), and elderberry (*Sambucus nigra*) in the 1860s (Thomson 1922). Several “edible” naturalizations have occurred since, notably species of passion vines (*Passiflora* spp.), kiwifruit (*Actinidia deliciosa*), loquat (*Eriobotrya japonica*), and even strawberry myrtle (*Ugni molinae*) on the Chatham Islands.

3.3.2 Forestry

Early settlers “mined” the native forests for timber and firewood but these regenerated too slowly for the multifarious demands made of homestead woodlots. Seeds of radiata pine (*Pinus radiata*), Scots pine (*P. sylvestris*), and macrocarpa (*Cupressus macrocarpa*) arrived in Canterbury and Auckland during the 1860s, and 47 important timber species had been introduced to Canterbury alone by 1925 (Clark 1949). Many of these are now widely naturalized.

The story of introducing conifers for forestry is highlighted in the development of Kaingaroa forest covering 188,000 ha of the central North Island, the largest man-made forest in the Southern Hemisphere. This was partly a social phenomenon; labor for planting was initially via prison reforms that sent men from unhealthy city gaols into the country to work, and later, via a steady supply of conscientious objectors to World War II (Boyd 1992). Trial plantings were made on this extensive upland volcanic plateau in 1896. Seeds were obtained from nurseries throughout the country and overseas, and planting began in 1906, mainly of Austrian pine (*Pinus nigra* subsp. *nigra*), bishop pine (*P. muricata*), Corsican pine (*P. nigra* subsp. *laricio*), and Australian gums (*Eucalyptus* spp). By 1911, 38 species had been planted (Boyd 1992). Obtaining seed for many species was difficult, but this did not apply to *P. radiata*, which soon superseded larch (*Larix decidua*) as the dominant Kaingaroa species, and thenceforth throughout the country.

Contorta pine (*Pinus contorta*) does not feature in this forest but does so at Karioi near Mt. Ruapehu, where large blocks were planted for pulp. Several pines are invasive in New Zealand, but contorta pine has the greatest ability to spread from plantations. Escapees from Karioi forest led to the largest ongoing weed control operation (apart from agricultural weeds) in New Zealand, centered on the volcanic landscapes of Tongariro National Park, adjacent tussock uplands used by the military, and the Kaweka Range. Several cold-tolerant conifer species, such as contorta pine, have large areas of herbaceous native habitat available to them because they can grow above the native tree limit. Douglas fir (*Pseudotsuga menziesii*) is the second most important forestry tree south of the Volcanic Plateau, and it too has spread. Unlike pines, however, this conifer tolerates shade, and there are concerns it may impact on *Nothofagus* forest regeneration, especially in the eastern South Island.

3.3.3 Erosion Control

The first willow introduced was the ornamental weeping willow (*Salix babylonica*), probably brought from Napoleon's grave on St. Helena to Banks Peninsula, South Island, in 1839 (van Kraayenoord et al. 1995). Many other species or cultivars were later introduced for riverbank stabilization. Crack willow (*Salix fragilis*) had naturalized along river margins and was causing flooding problems by 1880, as it has ever since (van Kraayenoord et al. 1995). Scores of other willow species and cultivars were planted widely in semi-natural wetland habitats and many have naturalized, to the detriment of the native biota.

Lowland areas were planted with many woody species to halt soil erosion. Most failed, but others, especially Tasmanian blackwood (*Acacia melanoxylon*) and false acacia (*Robinia pseudoacacia*), coral berry (*Symphoricarpos orbiculatus*), and species of *Tamarix*, persisted and spread from the 1970s onward (Sheppard 1972). Black or Lombardy poplar (*Populus nigra* cv. "Italica") survives from earlier plantings and is the most distinctive of all shelter trees, but it is less well established in the wild.

High-altitude *Alnus* and *Pinus* species from Europe and North America were hand-planted on scree slopes, and even aerially spread in an effort to control natural erosion at high altitudes. The result is a swathe of conifers in the mountains of the eastern South Island that will invade irreversibly for the foreseeable future.

Wind-blown coastal sand dunes also moved inland across farms, mostly in the western North Island following forest clearance. These were stabilized by the widespread planting of marram grass (*Ammophila arenaria*) and tree lupin (*Lupinus arboreus*), which have replaced native species over most of the sand dune country in New Zealand.

3.3.4 Horticulture

New Zealand was settled in the period of British history that coincided with the development of glasshouses, the creation of parks for the populace, the popularity of urban gardening aided by the first gardening magazines, and the invention of the Wardian Case for transporting plants. These early potted horticultural plants and those sent as seeds and bulbs, together with thousands more species later brought or sent for cultivation, constitute the main pathway for the majority of invasive species in New Zealand (Esler 1988). Most of these are now conceived as horticultural escapes, but this underestimates the early attempts at deliberately acclimatizing exotic plants directly into the landscape for aesthetic reasons. Most of these failed (Thomson 1922), but the purposeful spread of the colorful Russell lupins (*Lupinus polyphyllus*) transformed many sparsely vegetated habitats in the montane South Island, similarly to heather (*Calluna vulgaris*) that added cover and color to the Volcanic Plateau (for grouse habitat).

Flower gardens were growing in the Bay of Islands in the 1820s, and by the 1840s there were nurseries at Christchurch and Auckland. Plants initially came from England or Australia (Esler 1988), where plant nurseries were operative from the early 1800s in Sydney and the 1840s in Adelaide (Mulvaney 2001). The mid- to late 1800s was the heyday of plant collectors around the world, and New Zealand was on both the giving and receiving end of these efforts to introduce to Western Europe, North America, and by extension to a few other areas such as Australasia, as many of the world's ornamental plants as possible. In the 1860s and 1870s, Sir George Grey had an "almost endless" catalogue of plants on Kawau Island (Esler 1988), and private and public nurseries were well established in Dunedin and Christchurch. More than 200 suppliers now sell 30,000 plant taxa in New Zealand, the great majority of them exotic (Gaddum 1999).

3.3.5 Accidental Introductions

Aside from these thousands of purposeful introductions, most plant species naturalized before 1900 arrived accidentally via numerous pathways associated with goods and commodities, packing material, and ballast (Thomson 1922; Esler 1988). More than 20 European species had arrived unintentionally by the 1840s (Allan 1937), e.g., pimpernel (*Anagallis arvensis*), storksbill (*Erodium cicutarium*), alyssum (*Lobularia maritima*), broad-leaved plantain (*Plantago major*), giant buttercup (*Ranunculus acris*), and curled dock (*Rumex crispus*). As many as 104 species were reported from one load of ballast in 1896 (Esler 1988). Many species arrived as contaminants of seed for sowing, and were distributed in abundance. A single seed consignment listing

20 components actually contained 16 others, and by 1916 the Agriculture Department listed 221 exotic contaminants (Thomson 1922). Many were carried to open spaces in forest and fern on the backs of sheep imported in large numbers from Australia. Sand brome (*Bromus arenarius*) arrived probably as early as 1826 in this manner, and certainly many species of danthonia (*Rytidosperma*) and stipa (*Austrostipa* and *Nassella*) did (Allan 1937), the latter genus having originated in South America. Contaminants of potted plants had the advantage of being nurtured on their journey and distributed with the plants they hitched a ride with, e.g., oxalis (*Oxalis corniculata*). Accidental dispersal, particularly via contaminated road metal, is still an important means of species spread within New Zealand.

3.4 Regional Differences

The naturalized flora has followed the rise in total human population from 1830 onward (Fig. 3.2) but regional differences in naturalizations were evident from the outset, reflecting climate, land use and even the location of botanists. By the 1930s, 74% of naturalized species were first recorded from the North

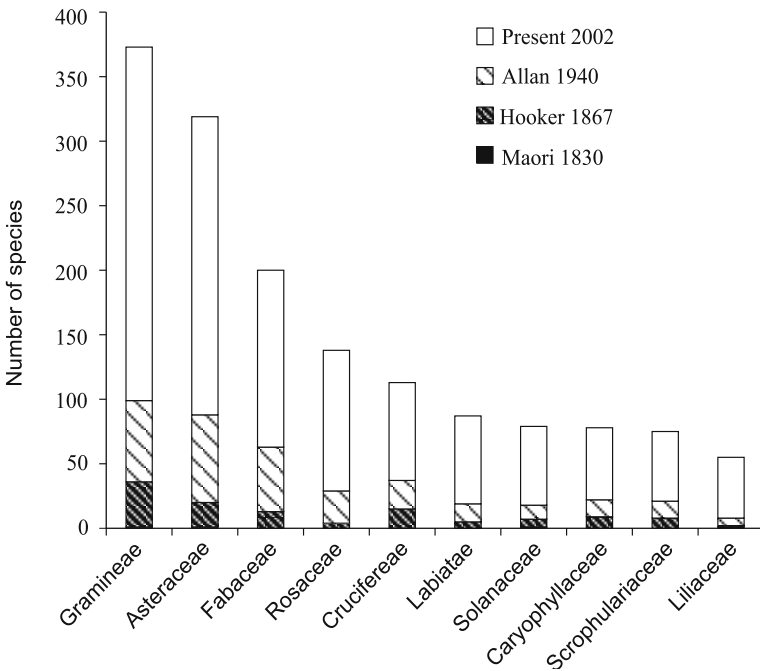


Fig. 3.1 The 10 largest families of the New Zealand naturalized flora at four time periods

Island where 65 % of the people lived (Allan 1937). Auckland was an early center of plant naturalization records, and has continued to be so – to the extent that it may be the weediest city in the world (Esler 1988). The distribution of recent naturalization records of some plants (e.g., Webb et al. 1988, 1995; Heenan et al. 1998, 1999, 2002) suggests this is closely related to the number of people in the region (Fig. 3.2). In all, 78 % of naturalization records in the last 15 years come from the North Island where the share of the population has risen to 76 %. Botanical collectors have never been evenly distributed either, which probably skews the values slightly. Certainly the moderate Auckland climate, lacking temperature extremes, and habitat diversity are important factors contributing to the city’s rich naturalized flora (Esler 1988), as well as the human population. These naturalization records are mostly closely associated with either neglected places with sparse cover or mixed woody vegetation, or in and around gardens and plantations or parks (Fig. 3.3a). Many records are unspecific as to land types but land adjacent to roadsides and tracks, as well as topographical features such as banks, cliffs, gullies and riparian areas (Fig. 3.3b), are vastly over-represented as sites for naturalizations, compared with the small proportion of their aerial contribution to the landscape. Combined with long-term observations of the naturalization process (e.g., Guthrie-Smith 1953), and the factors associated with the number of weeds in forest reserves (Timmins and Williams 1991; Sullivan et al. 2005), the conclusion is inescapable that human population pressure and all it implies has been, and will continue to be, a major factor behind regional differences in plant naturalization in New Zealand.

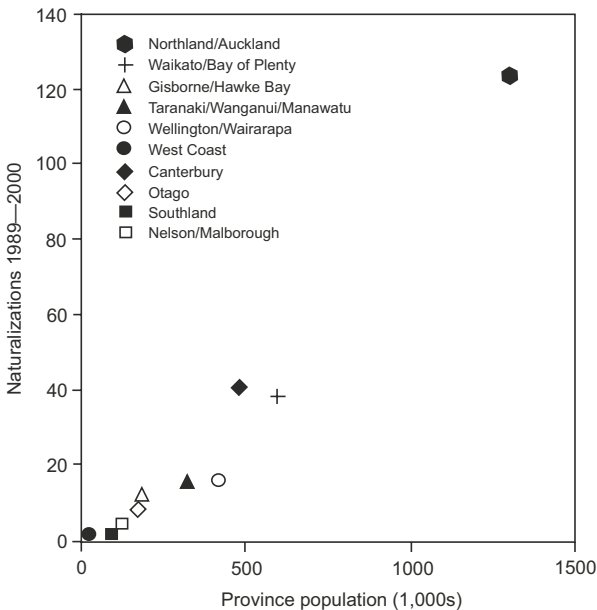


Fig. 3.2 Number of first naturalizations recorded from each of 10 provinces in New Zealand, and their human populations, for 1989–2000

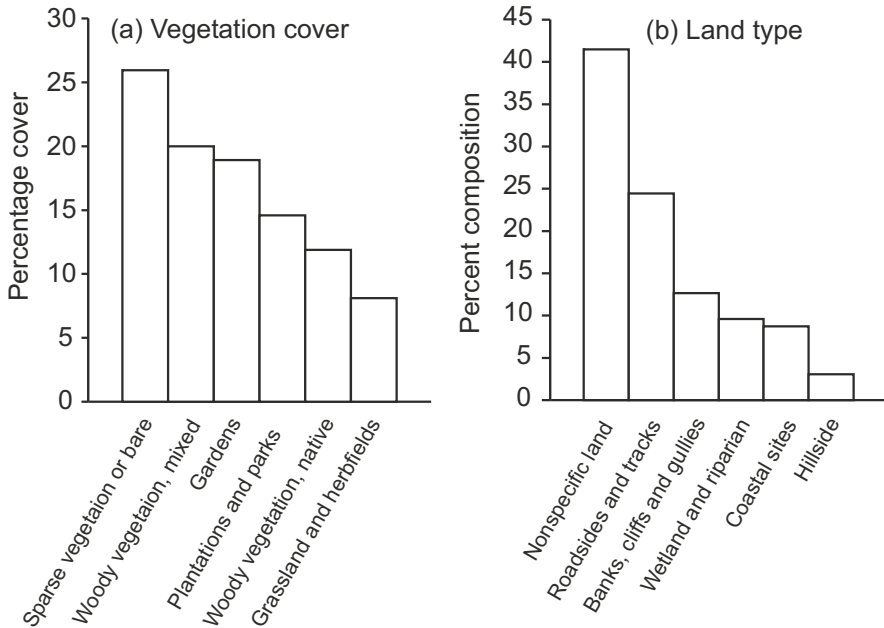


Fig. 3.3a Vegetation, and **b** land type of the localities where 267 first naturalizations were recorded in 1989–2000

3.5 Naturalized Flora

Development of the naturalized flora can be seen as occurring over four periods, after clarifying early records in the light of present-day taxonomy and greater certainty of species origins. The first period is the flora brought in by the Maori (i.e., pre-European), the second is early European to Hooker (1867), followed by middle European to Allan (1940), and finally from 1940 to 2002. The 10 families now comprising 52 % of the naturalized flora were dominant by 1867 (Fig. 3.1), but their rank order has changed, along with the pathways of introduction. Also, early escapes were mainly herbaceous, but time has allowed longer-lived woody species and climbers to escape, too (Fig. 3.4).

Not all species that appear spontaneously in the wild, nor those planted there, persist. There are numerous records of even widespread species declining for unknown reasons, e.g., water poppy (*Hydrocleys nymphoides*) and onion weed (*Asphodelus fistulosus*; Esler 1988). A larger proportion of the cultivated exotic flora fails even to reach the status of a casual naturalization, so that the naturalized flora is not simply a reflection of the total spectrum of

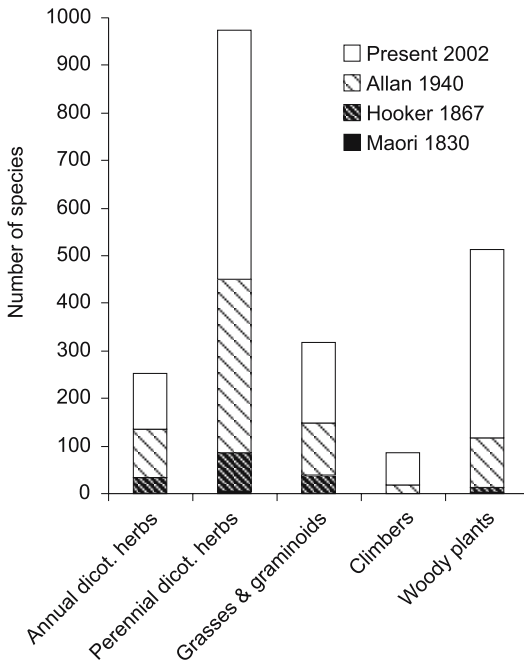


Fig. 3.4 Life-forms of the New Zealand naturalized flora at four time periods

accidental and purposeful introductions; some plant families and genera do significantly better than others. The total introduced New Zealand flora of some 28,000 species (<http://nzflora.landcareresearch.co.nz>) can be examined in relation to the total world flora and the naturalized flora. The 10 most species-rich families of these two groups together belong to 19 plant families (Table 3.1).

Amongst the world's most species-rich families, Melastomataceae has a low level of both introduction and naturalization in New Zealand (Table 3.1, group A), despite having many ornamental members and being arguably the worst invader of the tropical Pacific (W.R. Sykes, personal communication), e.g., miconia (*Miconia calvescens*). Rubiaceae, another large family of mainly tropical or warm-climate species that include important economic crops such as coffee, is represented in New Zealand's naturalized flora only by small herbs. Five of the world's most species-rich families are represented in New Zealand by less than 10% of their species, but they have high rates of naturalization (Asteraceae, Fabaceae, Poaceae, Labiateae, Scrophulariaceae; Table 3.1, group D) and are major contributors to the naturalized flora (Fig. 3.1). Solanaceae, which ranks only 19th in the world, is the 7th ranked naturalized family (Fig. 3.1). These are mostly cosmopolitan families well represented amongst the world's useful plants and weeds. Only two families (Orchidaceae, Liliaceae) with high introduction rates and low naturalization rates are within

Table 3.1 Plant introductions: the 10 most species-rich angiosperm families in the world (world ranks in parentheses), together with the 10 largest families to be introduced into New Zealand^a

Percentage of the world species introduced to New Zealand	Naturalized species as % of introductions	
	<10 %	≥10 %
≥10 %	A	B
	Orchidaceae (2)	Euphorbiaceae (6)
	Liliaceae <i>s. lat.</i> (9)	Brassicaceae (16)
	Ericaceae (15)	Rosaceae <i>s. lat.</i> (22)
	Ranunculaceae (26)	Caryophyllaceae (29)
	Bromeliaceae (27)	Iridaceae (39)
	Cactaceae (42)	
<10 %	C	D
	Melastomataceae (10)	Asteraceae (1)
	Rubiaceae (4)	Fabaceae (3)
		Poaceae (5)
		Lamiaceae (7)
		Scrophulariaceae (8)
	Solanaceae (19)	

^a The 19 families are grouped according to whether at least 10 % of the families are currently exotic in New Zealand (cultivated plus naturalized), and whether at least 10 % of these introductions are naturalized. They are divided into four groups (A–D) representing high (≥10 %) or low (<10 %) percentages of introduction and naturalization

the world’s top 10 most species-rich families. The others are lesser families, although Ericaceae ranks 15th. Orchidaceae, Bromeliaceae and Cactaceae are mostly horticultural plants from climates warmer and either wetter or drier than in New Zealand, whereas Liliaceae, Ericaceae and Ranunculaceae are tropical montane or temperate families. All six families have many useful species whereas the latter three are more commonly weeds in temperate regions. Other families with both high introduction rates and high naturalization rates are mostly temperate, especially northern temperate (Brassicaceae, Rosaceae, Caryophyllaceae), widespread tropical and subtropical (Euphorbiaceae), or with a more regional distribution (Iridaceae). All are well represented in both horticultural and weed floras.

The total exotic flora is thus a very biased selection of the world’s flora, consisting mostly of ornamental plants introduced for urban horticulture, and this is reflected in the composition of the resulting naturalized flora. The representativeness on a world scale of the naturalized flora is further skewed because the naturalized portion of these 19 families alone ranges from 0 % (Orchidaceae) to 49 % (Poaceae). This partly reflects climatic differences

between the source countries and New Zealand, although the diversity of habitats here has enabled the development of some very distinctive communities of naturalized plants, some of which are successful in local climates similar to that of their homelands. Examples are numerous species of Crassulaceae on the volcanic cliffs of Otago, Canterbury and Rangitoto Island in Auckland, the swathes of *Hieracium* species in the South Island, the striking Chilean rhubarb (*Gunnera tinctoria*) herbfields on coastal talus in Taranaki, the nascent palm forests of Chinese windmill palm (*Trachycarpus fortunei*) and Bangalow palm (*Archontophoenix cunninghamiana*) developing in Auckland's forests, and *Banksia integrifolia* invading North Island dune lands.

3.6 Attitudes Past and Present

The attitudes of botanists and the general public toward the naturalized flora have always been ambivalent. Warnings of the potential apocalyptic impacts of the naturalized flora on indigenous plants and vegetation appeared in the earliest writings of J.D. Hooker and others, supported by the pervading belief in the superiority of the Northern Hemisphere floras held by the evolutionists in the late 1800s. Hints of greater optimism occurred almost simultaneously in the writings of T. Kirk, but the pessimists were not seriously challenged before Cockayne at the turn of the century (Cockayne 1911), followed by others (Thomson 1922; Allan 1936), emphasized the importance of habitat modification to the success of exotic species. Stable communities encompassing both native and exotic species were envisaged, to the extent that even distinguishing between the two floras was considered scientifically unjustified (Raven and Engelhorn 1971). Healy and Edgar (1980) thought "native and adventive plants had called a truce", but this optimism coincided with the period before the world at large awoke to the wider impacts of invasive species. The envisaged refuges for native plants on "bold cliffs, and extensive sand dunes" (Thomson 1922, p. 532) are among the habitats most vulnerable to invasion (Fig. 3.3b), and they contain rare species for which naturalized plants are now the greatest single threat (Reid 1998).

3.7 Responding to the Deluge

The first Act to control weeds was passed in 1854 to prevent the spread of thistles as agricultural contaminants (Thomson 1922). Many subsequent legislative moves were made to control the spread of plants, and some were prevented from entry by the treaties of Government botanists to the border authorities of the day. It was not until 1998, however, that border biosecurity

legislation was passed making it illegal to import plant species not already in New Zealand that might affect the native biota. This legislation prompted a study of the weediness overseas of the exotic flora in cultivation and amongst the recent naturalizations referred to earlier, as a basis for developing effective risk-assessment systems for border control. Of the 267 first records of casual and fully naturalized species since 1989, only six were introduced accidentally, and one was for agriculture. The majority, 97 %, were introduced for urban horticulture. Of these, 156 (58.6 %) are sold in an average of 8.4 major nurseries (data from Gaddum 1999). About 60 % of these horticultural introductions, both sold and not sold, appear on an average of 7.5 weed lists overseas (data from Randall 2002). These are no less weedy than the few accidental introductions, which appear on 10.5 weed lists. Urban horticulture is responsible for the majority of new naturalizations. Well over half of these are known to be weeds in several other countries already.

The potential pool of invasive species still only in cultivation is enormous (>30,000 taxa), and moreover most naturalized species have yet to reach their present geographical limits (Fig. 3.5) – even without climate change. Those colonists who sought to transform wild New Zealand into a vast flower garden would not be disappointed if they returned, and in 100 years the colors are likely to be even more dramatic, as evidenced by the recent seaside expansions of the swathes of pink holly-leaved senecio (*Senecio glastifolius*) and yellow boneseed (*Chrysanthemoides monilifera*). In the deforested lowlands and open upland in all but well-tended places, the somber native flora has been largely overwhelmed. We now live amongst a largely untended garden of colorful exotics.

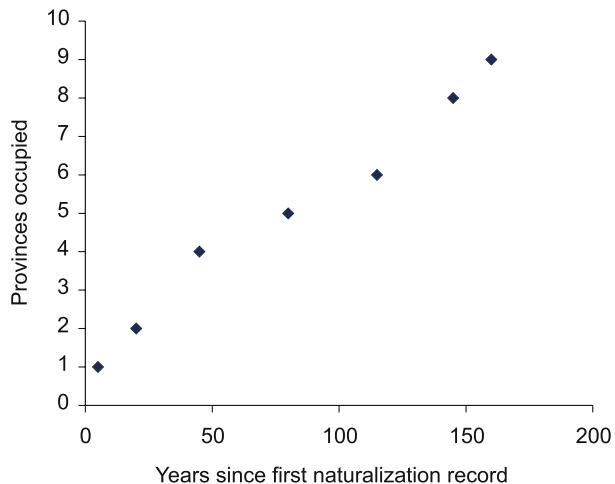


Fig. 3.5 Number of years since species first naturalized in New Zealand, and the mean number of provinces each now occupies. Data are for 1,914 species and seven periods from pre-1840 to 2000

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