6 Export of Plant and Animal Species from an Insular Biota

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6.1 Introduction

The deliberate and accidental establishment of exotic species in New Zealand is widely known. However, increasingly New Zealand native species are being introduced in other temperate regions of the world, and a significant proportion has become invasive. This chapter describes the establishment of native New Zealand plant and animal species elsewhere, and discusses the (varied) reasons for their success as exotic species. Charles Darwin (1859) wrote ..."we may doubt, if all the productions of New Zealand were set free in Great Britain, whether any considerable number would be enabled to seize on places now occupied by our native plants and animals". The assumption that insular biotas are inherently poor competitors continues, but the increasing spread of island species suggests otherwise. Because trade from New Zealand has only occurred over the past 150 years, opportunities for the native species to establish in other biogeographic regions are relatively recent. We adopt a case study approach to indicate the range of New Zealand species that have recently surfaced as invasive species in other countries.

6.2 Plant Emigrants

The major driver for the export of New Zealand native plants is the horticultural industry where the focus has been on interesting evergreen forms. The main New Zealand plant species considered invasive overseas are described, and a complete list presented in Table 6.1.

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Table 6.1 New Zealand plant species (in some cases also native to Australia) that are recorded as having naturalized or are listed as weeds in other countries[a]

Species	Family	Region of naturalization[b]	Dispersal method
Acaena novae-zelandiae	Rosaceae	Eur., N. Am.	Contaminant
Cardamine corymbosa	Brassicaceae	Aus.	Contaminant
Carex albula	Cyperaceae	Aus.	Horticulture
C. flagellifera	Cyperaceae	Aus.	Horticulture
C. testaceae	Cyperaceae	Aus.	Horticulture
Coprosma repens	Rubiaceae	Aus., Eur., N. Am., S. Afr.	Horticulture
C. robusta	Rubiaceae	Aus., Eur., N. Am.	Horticulture
Cordyline australis	Agavaceae	Pac.	Horticulture
Cortaderia richardii	Poacaeae	Aus., Eur., N. Am.	Horticulture
Corynocarpus laevigatus	Corynocarpaceae	N. Am., Aus., SEA, Pac.	Horticulture
Crassula helmsii	Crassulaceae	Eur.	Horticulture
C. sieberiana	Crassulaceae	N. Am.	?
Epilobium billardierianum	Onagraceae	Aus., Eur., N. Am.	Horticulture
E. brunnescens	Onagraceae	Eur.	Horticulture
E. komorovianum	Onagraceae	Eur.	Horticulture
E. rotundifolium	Onagraceae	Aus.	Horticulture
Hebe barkeri	Scrophulariaceae	Eur.	Horticulture
H. brachysiphon	Scrophulariaceae	Eur.	Horticulture
H. dieffenbachii	Scrophulariaceae	Eur.	Horticulture
H. elliptica	Scrophulariaceae	Aus.	Horticulture
H. parviflora	Scrophulariaceae	Aus.	Horticulture
H. salicifolia	Scrophulariaceae	Eur.	Horticulture
H. speciosa	Scrophulariaceae	Aus., N. Am.	Horticulture
Hoheria populnea	Malvaceae	N. Am.	Horticulture
Hydrocotyle tripartita	Apiaceae	Aus.	?
Kunzea ericoides	Myrtaceae	Pac.	Horticulture
Leptospermum scoparium	Myrtaceae	Pac.	Horticulture
Metrosideros excelsa	Myrtaceae	Aus., S. Afr.	Horticulture
Muehlenbeckia complexa	Polygonaceae	Aus.	?
M. ephedroides	Polygonaceae	Aus.	?
Myoporum laetum	Myoporaceae	Aus., N. Am.	Horticulture
Myriophyllum propinquum	Haloragaceae	Aus.	?
Olearia avicenniaefolia	Asteraceae	Eur.	Horticulture
O. traversii	Asteraceae	Eur.	Horticulture
Phormium cookianum	Agavaceae	Eur.	Horticulture
P. tenax	Agavaceae	Aus., N. Am., Pac.	Horticulture
Pittosporum crassifolium	Pittosporaceae	Aus.	Horticulture
P. eugenioides	Pittosporaceae	Aus.	Horticulture
Solanum aviculare	Solanaceae	Aus., Carib., N. Am.	Horticulture

[a] Data from Randall (2002)

[b] Regions denoted by: Aus., Australia; Carib., Caribbean; Eur., Europe; N. Am., North America; Pac., Pacific; South Africa, S. Afr.; SEA, South East Asia

Phormium tenax

A tall (2–3 m), closely tufted, perennial monocotyledon, *Phormiun tenax* ("New Zealand flax", Agavaceae), is perhaps the best-known invasive New Zealand plant species. Introduced to St. Helena in the South Atlantic for a fiber industry, it was grown on 1,200 ha before the industry collapsed in the 1960s. During this time, flax spread to modified woodlands and upland areas where it has since become a serious pest (Cronk 1989). Flax also grows on islands in the Tristan da Cunha group in the South Atlantic, having been used for traditional thatched houses (Wace and Holdgate 1976); it is currently a problem on Nightingale and Inaccessible islands (Roux et al. 1992). It was introduced to Hawai'i in the 18th century for fiber (Harris 1998), and has since escaped into gullies in mesic areas below 300 m a.s.l., e.g., on Moloka'i, and the northern Hamakua coastline (Smith 1998). In all these island groups, it forms dense thickets, similar to those of its native range, which exclude other species. Since the formation of the Diana's Peak National Park in St. Helena, there has been a control program by the Agricultural and Natural Resources Department to clear flax and replace it with a native species (R. Cairns-Wick, personal communication). *P. tenax* is also used horticulturally in the UK and USA (California). In both countries, it is infected with the native mealy bug *Balanococcus diminutus* (see Sect. 6.3.6).

Crassula helmsii

Crassula helmsii is a fine-stemmed, succulent, perennial herb ("New Zealand pigmyweed" or "Australian swamp stonecrop") that has invaded a wide range of static water habitats in the British Isles, where it changes wetland habitats and out-competes native species (Leach and Dawson 1999). Initially sold in 1927, the first naturalized collection was made in 1957. Since then, it has spread widely, partly as a result of its increasing horticultural popularity; one recent estimate suggests 10,000 sites have been colonized. *C. helmsii* grows mainly as a low turf, as it does in New Zealand, but stems may reach 1.3 m in length in open water, which is much longer than in its native range. It has yet to make the transition from static water bodies to flowing water, as in its native range (Centre for Ecology and Hydrology 2001). Despite the highly invasive nature of *C. helmsii*, it has no official weed status and little attempt is made to control it (Williamson 2002).

Metrosideros excelsa

Metrosideros excelsa, the "New Zealand Christmas tree", named after its show of red flowers in December, has become a major weed of the floristically rich

fynbos (fine bush, in Afrikaans) in the Western Cape, South Africa. It had been there since the 1940s, and by the 1980s was starting to spread and form dense thickets on sandy, nutrient-poor soils. After measuring the potential propagule pressure from established trees, Rejmánek et al. (2004) showed "wet" areas were more invasible by *M. excelsa* than "dry" areas. Efforts are underway to control its spread with the help of volunteer labor (Richardson and Rejmánek 1999). Interestingly, the exotic species that suppress *M. excelsa* in New Zealand are absent from the Western Cape. In New Zealand, the introduced brushtail possum (*Trichosurus vulpecula*) causes heavy damage on adult trees, and invasive herbs, particularly subtropical C4 grasses such as kikuyu grass (*Pennisetum clandestinum*), prevent seedling establishment. *M. excelsa* is used horticulturally in Australia and the USA (California), but has yet to become naturalized.

Coprosma spp.

Several native *Coprosma* species have been popular amenity plantings in Australia and South Africa. *Coprosma repens*, a coastal small tree in New Zealand, is a serious weed in south-east Australia and Tasmania where it invades vegetation types ranging from warm temperate rainforest to dry coastal vegetation (Blood 2001). It has also started to invade coastal areas of the Western Cape, South Africa. Seed dispersal seems to be via stormwater drains; unlike the situation in New Zealand and Australia, the local frugivorous birds are not acting as dispersal agents. It is not yet subject to control (D.M. Richardson, personal communication). *C. robusta* is naturalized in higher-rainfall areas of Victoria and Tasmania, but is not yet as widespread as *C. repens* (Blood 2001).

Carex spp.

Carex comans, *C. flagellifera*, and *C. testacea* are all naturalized in Australia where they were introduced for horticulture and are still widely sold. They have been introduced to Tasmania, and planted for roadside soil binding and beautification but have spread to adjoining pastures and woodlands where they impact on pasture production, and were proclaimed noxious in 1989 (Parsons and Cuthbertson 2001).

Corynocarpus laevigatus

Corynocarpus laevigatus ("New Zealand laurel") is a tall tree with a long history of cultivation on the Hawaiian Island group, including being broadcast from the air for reforestation purposes (Harris 1998). It has been further

spread by birds, and now forms dense thickets in mesic habitats at altitudes of 700–1,500 m a.s.l. (Smith 1998). These threaten the heau (*Exocarpus luteolus*), one of Hawaii's most endangered plant species (Harris 1998).

Kunzea ericoides and *Leptospermum scoparium*

These two shrubs or small trees were also introduced to the Hawaiian Island group about 80 years ago, and they have established on a few islands at mesic sites between 300 and 700 m a.s.l. (Smith 1998). They form dense thickets on ridge tops that have been bared by overgrazing.

6.3 Animal Emigrants

Flatworms

The "New Zealand flatworm" (*Arthurdendyus triangulatus*) stimulated interest in the spread and distribution of terrestrial planarians when it was reported to be responsible for reducing lumbricid earthworm populations below detectable levels in Northern Ireland (Blackshaw 1990). Similar adverse effects on Lumbricidae have since been confirmed in the Faroe Islands, and Scotland (Mather and Christensen 1992; Boag et al. 1999). *A. triangulatus* has the potential to become established in western continental Europe, stimulating increasing interest in the biology of, and quarantine risk posed by, this and other terrestrial planarians (Alford et al. 1998; Boag and Yeates 2001). There is concern that reduction in earthworm populations could adversely affect both soil conditions and wildlife dependent on native earthworms.

The verified European distribution of *A. triangulatus* in the mid-1960s was a single site in each of Northern Ireland, England and Scotland; there are, however, anecdotal reports of its presence in Northern Ireland and Scotland in the 1950s (B. Boag, personal communication). In Scotland, it was initially confined to central areas from where it spread principally north and west during the 1970s and 1980s, to reach the extremities of mainland Scotland by 1990 (Boag et al. 1997). Its spread from botanic gardens, garden centers and nurseries, to home gardens, and finally to farmland suggests that it was dispersed in association with container-grown plants from grower to wholesaler and eventually to retail purchasers. The early records of *A. triangulatus* from botanic gardens in Britain indicate it may have arrived with imported plant material. *A. triangulatus* has been recorded from a nursery on Banks Peninsula that had at one time exported plants to Britain (Alford et al. 1998), and so there is an association between the plant trade and spread of *A. triangulatus*

on both local and global scales. DNA evidence suggests *A. triangulatus* has been spread passively within both New Zealand and Northern Ireland (Dynes et al. 2001). Phylogenetic analysis supports the hypothesis of multiple introductions to the British Isles from New Zealand. Within the UK, prohibition on release of *A. triangulatus* has been made under the Wildlife and Countryside Act 1981.

In contrast to the UK, in New Zealand the native *A. triangulatus* and introduced Lumbricidae apparently coexist. Under New Zealand conditions, terrestrial planarians are generally not found in the extensive agricultural lands where Lumbricidae are abundant; they are rare in open fields that are hot and dry in summer. Terrestrial planarians are, however, common in older-style nurseries where plant pots sit on damp soil, and under debris around farm buildings and paddock boundaries. Populations of Lumbricidae in a long-term zero-till maize (*Zea mays*) paddock were greatly reduced, the maize debris providing refugia for planarians and, in the absence of cultivation-induced mortality, they multiplied sufficiently to reduce the Lumbricidae (Yeates et al. 1999).

The New Zealand species *A. australis* was found in Scotland in 1997 (Jones 1998). In addition to *A. triangulatus* and *A. australis*, two further terrestrial planarians introduced to the British Isles probably have New Zealand origins. The large, earthworm-eating *A. albidus* was first found in Midlothian, Scotland, in 1996. It is assumed to be a native of (but is not yet recorded in) New Zealand (Jones and Gerard 1999). The origins of the "Australian flatworm" (*Australoplana sanguinea alba*), which is established in England and apparently feeds on lumbricid earthworms (Santoro and Jones 2001), are uncertain but it may also be native to New Zealand. New Zealand and Australia have several species of terrestrial planarians in common, and their individual origins are uncertain (Boag and Yeates 2001). Outside Australasia, *Australoplana sanguinea alba* was first detected in the Isles of Scilly, and has spread to many sites in England and Ireland, with records from Scotland and Wales.

Antiponemertes pantini

The establishment of *Antiponemertes pantini* in the Scilly Isles provided its first record outside New Zealand (Moore et al. 2001). Terrestrial nemerteans are poorly known, but their increasing spread is attributed to international movement of plants, and from garden center movements within countries (Moore et al. 2001).

Potamopyrgus antipodarum

This small, freshwater snail was apparently transported from New Zealand to Tasmania in drinking water supplies on ships (Ponder 1988), and became established in streams around Hobart between 1829–1830 and the 1860s; it has since spread in south-eastern Australia. It probably entered Europe in the same way, suddenly appearing in the mid-19th century. The first record was from the Thames Estuary, and it has since spread through much of Europe, at first in brackish water and later in freshwater (Winterbourn 1972). In New Zealand, diploid sexual and triploid clonal individuals can frequently be found in mixed populations (Negovetic and Jokela 2001), whereas European populations are mostly, if not entirely, parthenogenetic (Wallace 1992). Using DNA fingerprinting, Jacobsen et al. (1996) concluded that *P. antipodarum* successfully invaded Europe by the proliferation of very few clones. In the USA, Lake Ontario (NY) is inhabited by the European freshwater clone, whereas the clone in four disparate areas in the western United States matches an Australian genotype (Dybdahl 2002). Monoclonal samples from Japan and Tasmania were similar to North Island populations. In New Zealand, snails may be sterilized when parasitized by trematode larvae, the prevalence of infection being related to the frequency of males (Lively 2001). There appear to be no reports of adverse effects of *P. antipodarum* colonization on European habitats, and Eno et al. (1997, p. 121) describe its effects on the environment as "unknown other than it eats water cress but that is not a concern as this snail is so small".

The first record of *P. antipodarum* in North America was in 1987, from the Snake River system in Idaho (Zaranko et al. 1997). It may have been first introduced via a fish farm, or ballast water from European boats (Gangloff 1998). *P. antipodarum* has been reported from the Great Lakes and several American states, where it is known as the "New Zealand mud snail". It is considered harmful, due to its potential to be a bio-fouler and to compete for food and space occupied by native snails (OTA 1993; Richards et al. 2001; USGS 2002). However, recent work suggests that snail grazing may stimulate algal growth, and that *P. antipodarum* may coexist with the endemic snail *Pyrgulopsis robusta* (Riley et al. 2002). North American *P. antipodarum* populations are predominately females, and no trematode infections have been recorded (Gangloff 1998). In at least Wyoming, there are regulations prohibiting its importation (Wyoming Game and Fish Commission 1998).

Achaearanea veruculata

The "cobweb spider", described from Auckland, New Zealand, is known from several collections on Tresco, Scilly Isles. It has recently been reported from Belgium (van Keer 1993). In both New Zealand and Australia, *A. veruculata* has potential to control spider mites and leafroller caterpillars (Wilson et al. 1998; HortResearch 1999).

Stick Insects

The sexually reproducing "smooth stick insect" (*Clitarchus hookeri*) is known from several collections from a garden in the Scilly Isles (Uvarov 1950; Haes and Harding 1997). *Acanthoxyla prasina geisovii*, the parthenogenetic "prickly stick insect", is known from the Scilly Isles, Cornwall and Devon, mainly from gardens. The earliest records are from 1907 and 1908 (Uvarov 1944; Haes and Harding 1997), and Uvarov (1944) considered that its appearance in the British Isles may be a sequel to the importation of a large number of live plants into the Scilly Isles in 1907 and 1908. *Acanthoxyla prasina inermis*, the parthenogenetic "unarmed stick insect", was first recognized in Britain in 1987, having previously been confused with *C. hookeri*. It has apparently been present in Cornwall since the 1920s, and there was a further introduction in the 1970s (Haes and Harding 1997). It is also established in the Kenmare River area of south-west Ireland (Haes and Harding 1997). The stick insects *Acanthoxyla* spp. and *C. hookeri* have a similar mode of colonization to *Achaearanea veruculata* (Merrett and Rowe 1961).

Balanococcus diminutus

This native species is a pest of ornamental *Phormium* (Agavaceae), not only in New Zealand, but also in South Australia, New South Wales, Europe and North America (Cox 1987; CSIRO 2002). It was described from New Zealand flax in Italy in 1918. It was first reported in the USA in 1906, and until the 1960s was localized in the San Francisco Bay area but became more widespread with the popularity of New Zealand flax in the 1980s (San Marcos Growers 2002). *B. diminutus* is considered to have been introduced into the UK on imported plants in the 1970s (Royal Horticultural Society 2002).

Ambeodontus tristis

The two-toothed longhorn beetle occurs throughout New Zealand wherever suitable tree hosts are found (Hosking 1978). The larvae bore into dead softwoods, and into living trees where wounds give access to heartwood. It is established in Australia (Tasmania), where it has been found in sawn timber imported from New Zealand. It is one of 15 wood-destroying insects claimed as susceptible to borate timber preservative (Advance Guard 2002).

Weevils

The wood-boring weevil, *Euophryum confine*, occurs throughout Britain and mainland Europe. In Britain, it is a significant factor in wood decay, both on domestic premises and in the wild (Thompson 1989). It was first recorded in England in 1940 (Green and Pitman 2003). In Britain, populations in wooden cellars and damp ground floors are usually in conjunction with wet rot fungi. *Euophryum rufum* is a similar wood-boring weevil to *E. confine*, and was also introduced into Britain from New Zealand (Thompson 1989), the first record being in 1934. Often it is not differentiated from *E. confine* in building surveys (Green and Pitman 2003).

Feather Wing Beetles

Ptinella cavelli and *P. taylori* are New Zealand species that were apparently introduced into the British Isles through the timber trade, and live under the bark of dead trees (Johnson 1982). *P. errabunda* Johnson was described from England, and is well established there but probably originated from New Zealand; it has also spread to Europe (Vorst 1993).

Rove Beetles

Teropalpus unicolor Sharp is well established on sandy beaches along the south and south-west coasts of Britain where it is associated with tidal detritus. It had colonized Britain by the beginning of the 20th century, and also occurs in Australia, South Africa and on the Pacific coast of North America (Hammond 2000). Although there are unresolved taxonomic problems, two species of *Carpelimus* from New Zealand are recent colonists in Britain. One, the smaller of the two species, had become established in England by 1968, and has since spread widely in Britain and is also found elsewhere in Europe. The second (apparently *C. zealandicus*) had become established in southern

England by 1997 (D. Lott, personal communication; P. Hammond, personal communication). No dispersal mechanisms have been postulated.

Dryadaula pactolia

This fungus/wood-eating moth has been established in parts of Britain since 1911. Several records are associated with cellars and warehouses (Heath and Emmet 1985). The larvae are recorded from the cellar fungus (*Coniophora puteana*). In New Zealand, the species is usually found indoors.

Planotortix notophaea

This leafroller was originally described from a specimen intercepted in 1921 on shoots of *Acacia decurrens* sent from Epping, New South Wales. *P. notophaea* is a New Zealand species, and in the 1920s there was an established population in a nursery that specialized in New Zealand plants in New South Wales (Dugdale 1966).

6.4 Conclusions

Very few native New Zealand plants have been economically useful and widely planted overseas (Harris and Heenan 1992) – among the invasive species, only flax was mass planted as a crop. Consequently, their economic impact as invaders has also been negligible on a global scale (Pimentel 2002). However, at least 39 New Zealand plant species in 22 genera have naturalized (i.e., formed self-maintaining populations in the wild) or become weeds in other regions, with impacts on a local scale (Table 6.1). Most of these 39 species are found in southern Australia or Europe (mainly southern England), and a few occur in North America (mainly California), South East Asia, the Pacific (mainly Hawai'i), and coastal South Africa. Most were introduced for horticulture, and even those regarded as contaminants have been spread via potted plants. This includes the many species of *Epilobium* that are more of a nuisance in gardens than serious invasive environmental weeds. *Acaena novae-zelandiae* ("bidibid") is widespread and was probably distributed by several vectors, including exported wool (e.g., Gynn and Richards 1985).

Those New Zealand plant species that have become invasive overseas derive mainly from non-forest habitats: open lands (*Acaena novae-zelandiae*, *Cortaderia richardii*, many species of *Epilobium*); wetlands (*Carex* spp., *Crassula* spp., *Phormium tenax*); exposed coastal habitats (*Coprosma repens*, *Hebe* spp., *Metrosideros excelsa*, *Muehlenbeckia complexa*, *Myoporum laetum*,

Olearia avicenniaefolia, *O. traversii*, *Phormium colensoi*); and early-successional vegetation (*Coprosma robusta*, *Hebe* spp., *Leptospermum scoparium*, *Kunzea ericoides*, *Pittosporum* spp., *Solanum aviculare*). Their native habitats are characterized by stress and disturbance, and in general, the habitats they have invaded offshore have similar characteristics. There are similarities with New Zealand climates in some regions, particularly for southern England and southern Australia. Other areas where New Zealand plants have invaded tend to be hotter (southern Africa, California and Hawai'i).

Mostly the invasive migrants produce copious quantities of seed that are either wind blown or dispersed by birds. Vegetative reproduction has not been generally conducive to the spread of New Zealand species overseas, although *Crassula helmsii* is a spectacular exception. Countries wishing to import New Zealand species for horticulture should avoid species with these characteristics and from the above habitats. Purposely planting exotic species into the natural environment frequently results in invasions requiring official control, illustrated here by *Carex* and *Phormium*. This practice, too, should be avoided.

The 39 plant species naturalized overseas represent 2.0 % of the New Zealand native angiosperm flora. That this is of the same order of magnitude as the percentage of the world's flora that has become naturalized in New Zealand (2,000 species) casts doubt on the assumption that island species are generally poor competitors. Exotic plants invading New Zealand show lags in their spread (Chap. 3). Assuming New Zealand species behave the same overseas, then both the number and extent of New Zealand species can be expected to increase when barriers to invasion are removed, e.g., when southern African birds learn to eat *Coprosma repens* berries.

In contrast to plants, the animals known to have been exported from New Zealand largely represent accidental transfers. *Potamopyrgus antipodarum* could be regarded as a forerunner of the late 20th century concern with ballast-water contaminants. *Balanococcus diminutus* has been translocated as an obligate associate of its host plant, *Phormium tenax*. Terraria (or Wardian cases; Ward 1842) played a part in some animal translocations but they were more commonly associated with the export of New Zealand plants. Timber has also been important in animal transfer. The contrast between deliberate and accidental transfers is highlighted by the formal taxonomic description of *Arthurdendyus albidus* from Scotland, of *Ptinella errabunda* from England, and of *B. diminutus* from Italy, rather than from New Zealand. Similarly, the terrestrial amphipod *Arcitalitrus dorrieni* was described from the Scilly Isles, rather than from Australia (O'Hanlon and Bolger 1997). The cluster of Australasian invertebrates established in the Scilly Isles is remarkable, and raises the issue of how many establishment events elsewhere remain undetected.

Potamopyrgus antipodarum apparently reached England from New Zealand via Australia. Subsequently, it has moved to continental Europe, Japan and North America. The continuing new records of exotic terrestrial

planarians from the British Isles also indicate that phytosanitary regulations are at least partly ineffective (Boag and Yeates 2001); perhaps they serve to at least reduce the flood that could otherwise accompany increasing volumes of international trade.

For several New Zealand animal species that are today regarded as problem organisms overseas, there appears to have been a variable lag between successful export and pest status. *P. antipodarum* was recorded as causing blockage in water supplies almost a century after its arrival in Australia (Ponder 1988), but concern about its effects in North American waterways was almost immediate. The terrestrial planarian *Arthurdendyus triangulatus* was apparently present in both Scotland and the Faroe Islands for some 25 years before adverse effects were observed. These two species appear to be utilizing resources not used by native species of the respective groups. Climatic conditions have been used to explain actual or potential distributions of both species (Ponder 1988; Boag et al. 1995). In the case of *P. antipodarum*, a lack of parasitism may be a contributing factor. If the delay in onset of parasitism of the millipede *Ommatoiulus moreletii* by a native rhabditid nematode in Australia (McKillup et al. 1988) is a realistic indication, natural development of parasitic control is likely to be a long-term phenomenon.

Sixteen species of stick insects are recognized in New Zealand, 15 of them being sexually reproducing whereas the parthenogenetic genus *Acanthoxyla* has a single species with seven subspecies (Salmon 1991). Although more than 10 exotic species of *Phasmida* occur in continental Europe, only three taxa have established as breeding outdoor populations in the British Isles. All three are from New Zealand; two other species are recorded from the British Isles following deliberate releases (Haes and Harding 1997).

The horticultural use of *Phormium*, *Metrosideros* and other New Zealand plants internationally, and the accumulating records of terrestrial planarians from New Zealand in the British Isles indicate that species from this insular biota continue to successfully challenge offshore ecosystems. The propensity for New Zealand plants to establish in, and exploit, disturbed habitats and the ability of New Zealand animals to exploit available resources in areas with suitable climates not only provide opportunities for further study, but should also alert ecologists to the potential for island biota to become invasive in any part of the world.

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