

Defining indigenous plants: some problematic species from Norfolk Island

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Abstract: Defining indigenous species may at first appear straight forward; most botanical texts provide similar definitions. The consistent requirement of such definitions is the lack of human intervention in the occurrence of the species within the area under consideration. Islands around the world have been invaded by plant species brought to their shores by humans. They are also places where self-introduced species can be continually arriving, as they have done for millennia.

Scrutiny of the situation on Norfolk Island (1200 km east of Australia) finds that the distinction between indigenous and introduced taxa is sometimes unclear. There is also inconsistency regarding the acceptance of self-introduced species as indigenous. This paper explores these issues and notes that they are more important than idle botanical curiosity, because control of introduced (weed) species is a major area of activity in managing protected natural areas.

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Introduction

The concept of the indigenous or native plant taxon, as opposed to one that is introduced (and commonly referred to as a weed), is in some situations not as easy to identify as may at first appear. Definitions of each term are easily constructed, but for some species in some situations the delineation becomes problematic. This problem is apparent on Norfolk Island (1200 km east of Australia), where complications over the status of some species arise because of factors including ambiguous early records and recent discoveries of species that may or may not have arrived unaided. For convenience, Norfolk Island (lat 29° 02'S; long 167° 57'E) refers here to the Norfolk Island Group as a whole.

Introduced taxa are often defined as those that are not native or indigenous (e.g. Harden 2002; Green 1994; Richardson et al. 2006). Although seldom stated, the definition implies non-intervention by humans. While it can generally be established, through a range of investigations, whether a plant species was present before Europeans arrived on Norfolk Island, there are cases, as we shall see, where the indigenousness of a species is anything but obvious. The

presence of Polynesian people hundreds of years before Europeans arrived further complicates the situation.

The examples presented here for Norfolk Island demonstrate the problem of defining indigenousness when faced with a range of information that is sometimes ambiguous, fragmentary or open to misinterpretation. The problem is not confined to Norfolk Island or to islands generally. An ambiguous species can have significant implications for the management of protected natural areas, where the goal is usually to remove introduced species.

The Flora of Norfolk Island

The earliest references to plants on Norfolk Island were by James Cook and accompanying botanists, father and son, Johann and George Forster, in the *Resolution* at the time of its European discovery in October 1774. Philip Gidley King, first commandant on the island from 1788, referred to several of the plants found on the island, most particularly to species of known or potential usefulness to the settlement. The earliest attempt to catalogue the plants was an annotated list of 48 species prepared by William Paterson, in charge of the military detachment on Norfolk Island from November

1791 to March 1793. Paterson's notes accompany a set of 50 corresponding numbered watercolour drawings attributed to his convict servant John Doody.

Ferdinand Bauer visited Norfolk Island in 1804/05 and made extensive collections of plants and drawings. Botanist Allan Cunningham visited in 1830, making an extensive list of the plants he observed on the island; he created names for some of the endemic species but these names were never formally published by him or anyone else. The first *Flora* of Norfolk Island, based on the work of Bauer, was prepared by Stephano Endlicher (1833), who formally described most of the endemic species. The next comprehensive treatment of the flora was not until early in the 20th century (Maiden 1904; Laing 1914). Green (1994) prepared the modern *Flora* as part of the *Flora of Australia* series. Since then, several papers have dealt with various aspects of the island's flora (e.g. Braggins 1996; Lange et al. 2005; Mills 2007, 2010).

The flora of Norfolk Island (latitude 29° 02' south) is subtropical in character and, not surprisingly, exhibits affinities with the closest landmasses, particularly those to the west; 51 percent of the species is shared with Australia, 33 percent with New Zealand, 21 percent with New Caledonia and 6 percent with Fiji (Mills 2007). About 39 percent is shared with Lord Howe Island, the closest land to the west (about 900 km away). The high percentages for Australia and Lord Howe Island can be explained by the fact that the weather systems approach from the west, so that the likelihood of transport of plant propagules is highest from that direction.

The Norfolk Island flora consists of a coastal flora, ubiquitous in the southwestern Pacific region and elsewhere, and a rainforest flora derived from the above landmasses. Endemic taxa represent 24 percent of the indigenous flora. Most of Norfolk Island has been cleared of its original rainforest vegetation since convict times; i.e. pre-1850. The majority of the remaining indigenous vegetation is contained within Norfolk Island National Park and Botanic Garden, managed by Parks Australia, an Australian Commonwealth Government authority (Director of National Parks 2008). These reserves cover 18 percent of the land area of the island group.

Species Indigenous or Introduced

A suite of plant species on Norfolk Island cannot readily be categorised as indigenous or introduced. The examples discussed below demonstrate the problems of defining indigenesness on Norfolk Island.

Historical ambiguity

The rampant creeper *Ipomoea cairica* (Convolvulaceae) is ubiquitous across the western Pacific and a common coastal plant in eastern Australia. Generally considered to be introduced to Norfolk Island, it is usually treated as an

invasive weed (e.g. Director of National Parks 2008) and vigorously destroyed on the island whenever possible (K. Mills, pers. obs.). The plant appears on a set of Norfolk Island postage stamps depicting the important weeds of the island. However, Lange et al. (2005) suggested that the species may in fact be indigenous, citing the very early drawing by the convict artist John Doody from about 1792; i.e. four years after settlement. However, *Ipomoea cairica* is one of three species in that genus illustrated among the set of 50 drawings of Norfolk Island plants; the other two being *Ipomoea alba* (as *Ipomoea* sp.) and *Ipomoea indica* (as *Ipomoea congesta*). These two species are definitely introduced to Norfolk Island as they are of tropical origin (Harden 1992; Green 1994). Thus, the early drawing of *Ipomoea cairica* cannot be accepted as conclusive evidence of an indigenous status.

Beach plants were some of the first plants recorded for Norfolk Island by Europeans. James Cook and his party landed on the shore of Duncombe Bay on the north-eastern side of the island in 1774 (Beaglehole 1969). Cook wrote, 'on the isle is fresh water and abundance of Cabbage Palms, Wood Sorrell, Sow-Thistle and Samphire, with which the Shores in some places abound. We brought on board as much of each sort as the time we had to gather them would admit.'

The identity of Cook's 'Sow-Thistle' is problematic. Sow Thistle is the name given to species of *Sonchus* in Britain. In non-botanical texts, the identity of the plant is usually said to be *Sonchus oleraceus* (e.g. Beaglehole 1969; Nobbs 1988). This is unlikely, as that species was not introduced to Australia or anywhere else nearby until settlement in 1788. Lange et al. (2005) suggested either *Sonchus kirkii* or *Actites megalocarpus*, the former found in New Zealand and surrounding islands where it is apparently declining in abundance, the latter species is native to Australia where it grows on sand dunes and beaches along most of the coastline; it also occurs on Lord Howe Island where its indigenous status has been questioned (Green 1994). For the identity of the plant mentioned by Cook, we perhaps need go no further than a species in the same family (Asteraceae) that is still common at Cook's landing place on Norfolk Island today, namely *Senecio australis*. The small, yellow, daisy-like flowers of this species could have looked like a Sow-thistle to Cook and his shipmates as they had no other name to give it. The botanists accompanying Cook, Johann and George Forster, offer no clue as to the identity of the species. George Forster recording only that 'on the beach we found several succulent plants, such as a species of tetragonia [*Tetragonia tetragonoides*], and a mesembryanthemum [*Carpobrotus glaucescens*] ...' (Forster 2000).

Recent arrivals

Several recent arrivals of plant species on Norfolk Island are worthy of consideration in this discussion. The mistletoe *Ileostylus micranthus* (Loranthaceae) arrived apparently unaided from New Zealand in the 1930s. It is regarded as

indigenous and even though it preferentially parasitises the endangered endemic small tree *Coprosma pilosa* (Rubiaceae), it is not controlled. In fact, the mistletoe is itself listed as vulnerable under Australian Commonwealth legislation.

Ferns have been arriving on Norfolk Island since the island emerged from the ocean some three to two million years ago. A recent arrival, *Dicranopteris linearis* (Gleicheniaceae), has established a small colony on a road-cutting above Ball Bay. It was not recorded by Green (1994), being first recognised in 1995 (Braggins 1996). Its occurrence is seen as 'natural', having apparently arrived without human assistance. This species occurs widely in the Pacific region and is regarded as indigenous to Norfolk Island (e.g. Lange et al. 2005), but is not listed as threatened.

The tree *Delarbrea paradoxa* (Araliaceae), a native of New Caledonia, New Guinea and other tropical islands, is treated as introduced by Green (1994). Sometime prior to the time the plant was first noticed, a group of Red-crowned Parakeets *Cyanoramphus saisseti* from New Caledonia was reported on Norfolk Island; it is thought that the birds brought seeds of this species to the island (O. Evans, pers. comm.). Other potential seed carriers such as the Long-tailed Cuckoo, *Eudynamis taitensis*, visit Norfolk Island on their migration between New Zealand and New Caledonia. Lowry (1986) suggested this tree 'is probably the best adapted member of the genus for long-distance dispersal to and establishment in new areas' and further that 'this taxon has fleshy purplish black fruits that appear to be well adapted for bird dispersal'. *Delarbrea paradoxa* evolved in New Caledonia and has spread as far as Timor, almost 5,000 km to the west (Lowry 1986); the distance south to Norfolk Island is only 800 km. This tree is very unlikely to have been brought to the island by humans.

On Norfolk Island, *Delarbrea paradoxa* grows in rainforest and thickets of African Olive, *Olea europaea* subsp. *cuspidata* (Oleaceae), in the western parts of the national park. Various species of fleshy-fruited rainforest trees have been brought to the island over millennia by visiting birds; indeed many are still growing there. Paradoxically given the approach described above to *Ileostylus micranthus* and *Dicranopteris linearis*, *Delarbrea paradoxa* is currently regarded as an invasive weed and is removed when encountered in the national park (C. Rowston, Park Manager, pers. comm., July 2010).

The short-lived rainforest tree *Homalanthus populifolius* (Euphorbiaceae) is occasionally encountered in rainforest gullies on Norfolk Island. To a botanist from eastern Australia, where the species is common in a similar type of rainforest, this species does not look out of place on the island. The species is indigenous to Lord Howe Island (Green 1994), and was accepted as indigenous on Norfolk Island by Green (1994) but more recently has been considered introduced (Lange et al. 2005), because of the comment by Maiden (1904) that the species 'had come as a seedling with some

plants from Lord Howe Island.' Maiden wisely observes, 'it is interesting to trace the history of a plant like this, as a botanist might be excused for recording it without question as indigenous to Norfolk Island.'

Verification through pollen studies

The wetland plant *Typha orientalis* (Typhaceae) is common in eastern Australia, where it is regarded as a weedy invader of drains and artificial ponds, even though it is indigenous. The species also occurs in eastern Asia and some tropical islands, and is indigenous to New Zealand and the Kermadec Islands. On Norfolk Island, Green (1994) treated the species as native, but commented that it was 'possibly an early introduction'. The indigenous status of the species was proven beyond doubt by Macphail et al. (2001) through pollen from a core taken in Kingston Swamp, showing the species was present over 2000 years ago.

Pre-European introduction

The flax *Phormium tenax* (Hemerocallidaceae) of the island has always been considered to be indigenous (e.g. Green 1994). Recently, questions have been raised as to its indigenous status (Macphail et al. 2001; Coyne 2009a). Although present in 1774, the year of European discovery of the island, there is conjecture that Polynesians introduced the species to Norfolk some hundreds of years earlier. Mills (2009) found that there was no firm evidence of Polynesian introduction, although he did not completely discount the possibility. The author particularly questioned the validity of the interpretation of the pollen analysis by Macphail et al. (2001) that purported to show that *Phormium tenax* was not on the island prior to Polynesian arrival because of an absence of flax pollen. When Philip Gidley King arrived to settle Norfolk Island in March 1788, he found bananas growing on the island, confirming that Polynesians had been there. More recently, archaeological investigations below the sand dunes at Emily Bay have shown that Polynesians established at least a small temporary settlement on Norfolk Island. Reported differences in the physical features of the Norfolk Island plants compared to New Zealand plants (M. Christian, Norfolk Island, pers. comm.) and the habitat in which they grow do seem to support an indigenous status. In all likelihood, *Phormium tenax* is indigenous to Norfolk Island, as there is no real evidence that it was brought there by Polynesians. This author is not convinced that this species should be treated as a weed and its use in vegetation rehabilitation ceased, as suggested by Coyne (2009b).

Grasses – the most problematic of all

The grasses pose a particularly difficult group to deal with for several reasons; they were never very common on the island, they do not appear to have been well-documented in the early years of settlement, and even experienced botanists

often overlook them. This is evident in the list of grasses prepared by Cunningham in 1830, who spent four months on the island but did not record several species of grass known to be present, although this may be explained because he was on the island in winter.

Many grasses produce structures attached to their seeds that are sticky or have hooks or hairs that are readily transported by birds. Eastern Australian grasses that reached Norfolk Island by means of avian vectors would have found suitable habitat on sea-cliffs and dry ridges free of dense rainforest. Just as easily, the first European settlers to Norfolk could have inadvertently transported those same species from Sydney. Early observations and collections by the first botanists give the impression that the island was almost without grasses. Philip Gidley King wrote, 'not a single blade of grass has been seen on the island' (Fidlon & Ryan 1980). Endlicher (1833), based on Bauer's collections and drawings from 1804–1805, described eight species of grass for the island; three of these are now considered to be introduced.

The number of grass species recognised on the island climbed as successive botanists visited or investigated the flora. The number of species considered indigenous grew

from eight in 1833 to 13 in 1994 and presently stands at 15 species. At the same time, identified introduced taxa grew from none to 55. Over that period, acceptance of species as indigenous and introduced swayed backwards and forwards; today there is no universal consensus about several species. A few examples will serve to illustrate the dilemma. The species *Cymbopogon refractus*, *Echinopogon ovatus* and *Lepturus repens* were recorded in the diary of Allan Cunningham in 1830, 42 years after settlement; each is regarded as indigenous to the island. *Bothriochloa macra* on the other hand, is considered to be introduced, Green (1994) commenting that it was 'introduced to the island as a pasture grass'. The species was apparently first recorded on the island in 1902 by Maiden (1904). This may seem a late record for an indigenous species, after 114 years of settlement, but no botanist is known to have visited the island between 1830 and 1902, so the grass could have easily been overlooked. Cunningham listed only five species of grass, so his list cannot be regarded as comprehensive. It is unlikely to have been introduced as a pasture grass, as suggested by Green (1994), as the species is regarded as being rather unpalatable to stock (e.g. Lamp et al. 1990).

Table 1. Status of plant species on Norfolk Island discussed in this paper

Species	Growth habit	Earliest record	Current Status/Opinion Key Reference(s)
<i>Bothriochloa macra</i>	Grass	1902	INTRODUCED Maiden (1904); Green (1994)
<i>Cymbopogon refractus</i>	Grass	1830	INDIGENOUS Cunningham (1830); Green (1994)
<i>Delarbraea paradoxa</i>	Tree	unknown	CONSIDERED AN INTRODUCED WEED. Green (1994)
<i>Dicranopteris linearis</i>	Fern	1995	ONE LOCATION, CONSIDERED INDIGENOUS. Braggins (1996); Lange et al. (2005)
<i>Echinopogon ovatus</i>	Grass	1830	INDIGENOUS. Cunningham (1830); Green (1994)
<i>Homalanthus populifolius</i>	Tree	1902	INTRODUCED FROM LORD HOWE ISLAND. Maiden (1904); Green (1994)
<i>Ileostylus micranthus</i>	Shrub	1930s	INDIGENOUS AND LISTED AS VULNERABLE. Green (1994)
<i>Ipomoea alba</i>	Creeper	c.1792	INTRODUCED. Paterson/Doody (c.1792); Green (1994)
<i>Ipomoea cairica</i>	Creeper	c.1792	STATUS INCONCLUSIVE. Paterson/Doody (c.1792); Green (1994); Lange et al. (2005)
<i>Ipomoea indica</i>	Creeper	c.1792	INTRODUCED. Paterson/Doody (c.1792); Green (1994)
<i>Lepturus repens</i>	Grass	1830	INDIGENOUS. Cunningham (1830); Lange et al. (2005)
<i>Paspalum distichum</i>	Grass	2007	INTRODUCED (?), Mills (2007)
<i>Phormium tenax</i>	Large herb	1774	MOSTLY CONSIDERED AS INDIGENOUS. Green (1994); Mills (2009); Coyne (2009a)
<i>Sonchus oleraceus</i>	Herb	1830	INTRODUCED. Cunningham (1830); Green (1994)
<i>Typha orientalis</i>	Reed	2,000 yrs bp	INDIGENOUS; RECORDED IN POLLEN IN SWAMP AT KINGSTON. Green (1994); Macphail et al. (2001)

In 2007, the wetland grass *Paspalum distichum* was discovered on Norfolk Island (Mills 2007). The grass was found to be quite common on some low-lying, moist paddocks in the western part of the island. The species could have been transported by waterbirds, which regularly visit the island; this could have been recent or the species could have been present for many years. The grass could easily have been overlooked amongst the dense, heavily grazed grass sward in which it grows. Perhaps significantly, the grass is reported as introduced to the Kermadec Islands (Sykes & West 1996), located at the same latitude as Norfolk Island and about 1400 km to the east.

Discussion and Conclusion

The comment by Laing (1914) is no less apt today than when he visited Norfolk Island in 1912: 'one may feel comparatively sure that the list of Norfolk Island species has been stuffed with aliens; but when it comes to examining the title of any particular species to appear, difficulties are in most cases encountered'.

The lists of indigenous and introduced plants on Norfolk Island are constantly changing; new species arrive, taxonomic studies modify our understanding of species resulting in name changes and status, and historical studies can turn up more information. The number of species documented in the *Flora* of 1994 is 171 indigenous and 274 introduced (Green (1994); the figures in 2010 are respectively, 181 and 378 species (Mills 2010).

The examples cited above from Norfolk Island illustrate the problem of categorising species as indigenous or introduced (Table 1). Early botanical collections, descriptions and drawings, and even rather obscure journal notes can identify if a species was present on the island at the time of first European contact. Caution is always required, as in the case of *Ipomoea cairica*, and where ambiguous names are used. Palynological studies can confidently confirm the presence of some species but must be cautiously used to determine the absence of a species, as shown in the case of *Phormium tenax* (Mills 2009). Inconsistency between the approach taken to species that can be proven to be of the same status is inexplicable. One can contrast the approach to *Delarabrea paradoxa* to that of *Ileostylus micranthus* and *Dicranopteris linearis*. While the tree *Delarabrea* is regarded as a weed to be eradicated, the mistletoe is a listed threatened species and the fern is considered indigenous.

For species of uncertain status, future investigations as to their indigenous status may or may not reach a firm conclusion. Careful research, ranging from close study of historical material, including early collections, palynological investigations and possibly DNA analysis, can establish without doubt the indigenous status of most plant species in places like Norfolk Island. However, there will inevitably

be some species that cannot confidently be placed in the indigenous category. This can pose a dilemma for the manager of a protected area if a problematic species is invasive and negatively impacting upon other species. Such is the case with *Ipomoea cairica* and, potentially, *Delarabrea paradoxa*. These species have usually been treated as weeds and control measures implemented. This paper does not offer an absolute solution to the problem, but suggests that there must be a consistent approach. With this in mind, it is suggested that *Delarabrea paradoxa* be treated as indigenous. *Ipomoea cairica* is abundant on the island and control measures will never result in its local demise. As this rampant creeper can smother other vegetation, its control can perhaps be justified in areas where rainforest regeneration is being promoted, even if it is indigenous.

The issue of indigenoussness is more important than idle botanical curiosity. Introduced plants or weeds are a major area of activity for the managers of protected natural areas. Introduced plants are considered detrimental to natural values, and depending upon their invasive nature, are targeted in weed control programs. The manager can face a dilemma if there is controversy over the indigenous status of a species. The flora of most regions contains indigenous species that have a weedy habit; such species specialise in colonising disturbed areas and are often short-lived. The reserve manager is not as interested in subtle arguments over an indigenous versus a non-indigenous status as in knowing whether control measures are required. Among other things, this can have budgetary implications.

Establishing the Norfolk Island status of the species discussed here would assist the manager of the national park and other public reserves in deciding upon resource allocation; if a plant is indeed indigenous then it should not require control. As we have seen, the dilemma for the land manager may not be readily resolved. Unless the species is a particularly invasive plant, then the matter is not likely to be of great importance. The problem arises if the species is an aggressive species that expands at the expense of other indigenous species and has a negative impact on habitat values. In the case of Norfolk Island, should the tree *Delarabrea paradoxa* be accepted as indigenous and allowed to grow and expand? Consistency of approach suggests that it should. Based on the listing of *Ileostylus micranthus* it could even be a candidate for threatened species listing.

Several species of bird have 'self-introduced' to Norfolk Island since European settlement; these are today regarded as native species (Christian 2005), even though they may only have been able to successfully colonise the island because of the open habitats made available following clearing of the original forest. Should we consider self-introduced plants any differently?

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