

Naturalizing non-local native trees at Botany Bay: The long-term impact of historical plantings

By Doug Benson and Georgina Eldershaw

Non-local 'native' species used in historical plantings at Captain Cook's Landing Place are spreading into bushland. What can we learn from the long-term impact of this site's well-intentioned but ecologically inappropriate plantings?



Figure 1. Celebrations at Captain Cook's Landing Place during the 1956 Anniversary of Cook's landing. Efforts to 'beautify' the site of the first landing of Europeans on the east coast of Australia included the planting of non-local native trees, some of which have become weeds. Removal and management of these species is appropriate not only to protect this important conservation area, now within Botany Bay National Park, but also to help visitors visualize the landscape that presented itself to Cook in 1770.

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Introduction

The site of Lieutenant James Cook's first landing in Australia on 29 April 1770 is on the southern shores of Botany Bay, on the Kurnell Peninsula, approximately 16 km south of Sydney, New South Wales, Australia. From here the botanists Joseph Banks and Daniel Solander made the first scientific collections of the eastern Australian flora.

The landing site is now within the Botany Bay National Park.

The area immediately surrounding the landing site, and associated commemorative monuments, has changed considerably since Cook's visit (Box 1). It is now largely mown grass parkland with planted trees, perhaps the most visually prominent being the Norfolk Island Pines (*Araucaria heterophylla*) (Fig. 1). In addition to the pines,

Box 1. Historical context

In 1770 Lieutenant James Cook, together with the botanists Joseph Banks and Daniel Solander, landed at Botany Bay, the first European exploration of the east coast of Australia. The landscape they explored at Kurnell was the country of the Gweagal people of the Dharawal Aboriginal nation (NPWS 2002). The historic site of Captain Cook's landing at Kurnell was made a public reserve in 1899 and placed under the care and management of the Captain Cook's Landing Place Trust. Prior to reservation the natural bushland had been severely degraded by nearly 80 years of grazing. The Trust's response to the degradation was, quite reasonably, a program of tree planting and control of grazing stock. In their Annual Report of 1912–1913 the Trust outlined a program of planting that was to continue more or less until 1970.

'Since 1905, upwards of 650 young trees and plants, exclusively of Australian species, and chiefly typical of New South Wales coastal vegetation, have been planted out. For the supply of these plants the Trustees are indebted mainly to J. H. Maiden, Esq., F. L. S., Director of the Botanic Gardens, and also R. D. Hay Esq., Director of Forests.'

Over the next 60 years, up to 300 seedlings were planted out each year, in late autumn or early winter, about 10–20% of which were generally to replace previous losses. The Trust had a general policy of only planting Australasian species, with seedlings either being raised on the reserve, provided by the Botanic Gardens, or purchased commercially. Some transplanting of local native species was done, especially of Bangalay (*Eucalyptus botryoides*) and Coast Banksia (*Banksia integrifolia*). No comprehensive lists of species planted are available though there are occasional references to genera or species in the Annual Reports. *Eucalyptus* species are generally not identified, simply referred to as eucalypts. Many of the eucalypts planted were part of the research collection used by J. H. Maiden for his *Critical Revision of the Genus Eucalyptus*, and are thus likely to have included a wide range of species. Additional to the seasonal tree planting program, commemorative trees were planted by visiting dignitaries on the occasions of the anniversary of Cook's landing and Cook's Birthday (University of Sydney 1999). These trees were often species of *Araucaria*, particularly Norfolk Island and Cook Pines (*A. heterophylla* and *A. columnaris*, respectively) and are now a conspicuous sight near the monuments.

The first specific reference to planting of Tallowwood is in the 1921–1922 Annual Report in a list that also refers to '*Eucalyptus ficifolia*, *E. punctata*, *E. loxophleba* and *E. pyriformis*'. However, it can be assumed Tallowwoods were first planted much earlier than this as William Houston (a former Trust President) reports in 1923 that Tallowwoods could 'be seen in the Reserve upwards of 20 feet high and in vigorous growth'. Houston also records that the species was chosen for its attractive foliage.

The first Tallowwood plantings would have been within the area immediately surrounding the landing place and associated monuments, a supposition supported by the finding that this area now contains the largest trees. However, the 1929–1930 Annual Report confirms that later plantings were made into relatively undisturbed bushland. By the 1930s the Trust had identified which trees were most successful on the site and were primarily planting Tallowwood, Turpentine, Brush Box and Bangalay. The program included replacing the indigenous Angophoras (*Angophora costata*) in the bushland towards the ocean side of the Reserve. The planting program was evidently considered successful, and in 1944 the Superintendent and Curator of Taronga Zoo, Mr Patten, reported on the fine growth of Tallowwood, generally regarded as the finest of the introduced trees in the Reserve.

By the early 1950s the regular tree-planting program was scaled down, apparently not by choice, rather due to the pressures of maintaining facilities for an increasing number of visitors to the Reserve. The Trustees, however, continued to replace trees that were lost due to fire, drought and gales. When the National Parks and Wildlife Service took over control of the Reserve in 1967 further tree planting was limited to local species.

Since this time, the superficial resemblance of Tallowwood to the native species at Kurnell, particularly Swamp Mahogany (*Eucalyptus robusta*) and Bangalay (*Eucalyptus botryoides*), may have allowed it to go unrecognized in Kurnell bushland, though records at the National Herbarium of NSW include a specimen of Tallowwood collected at Kurnell in 1976, annotated that the species was naturalizing at that time.

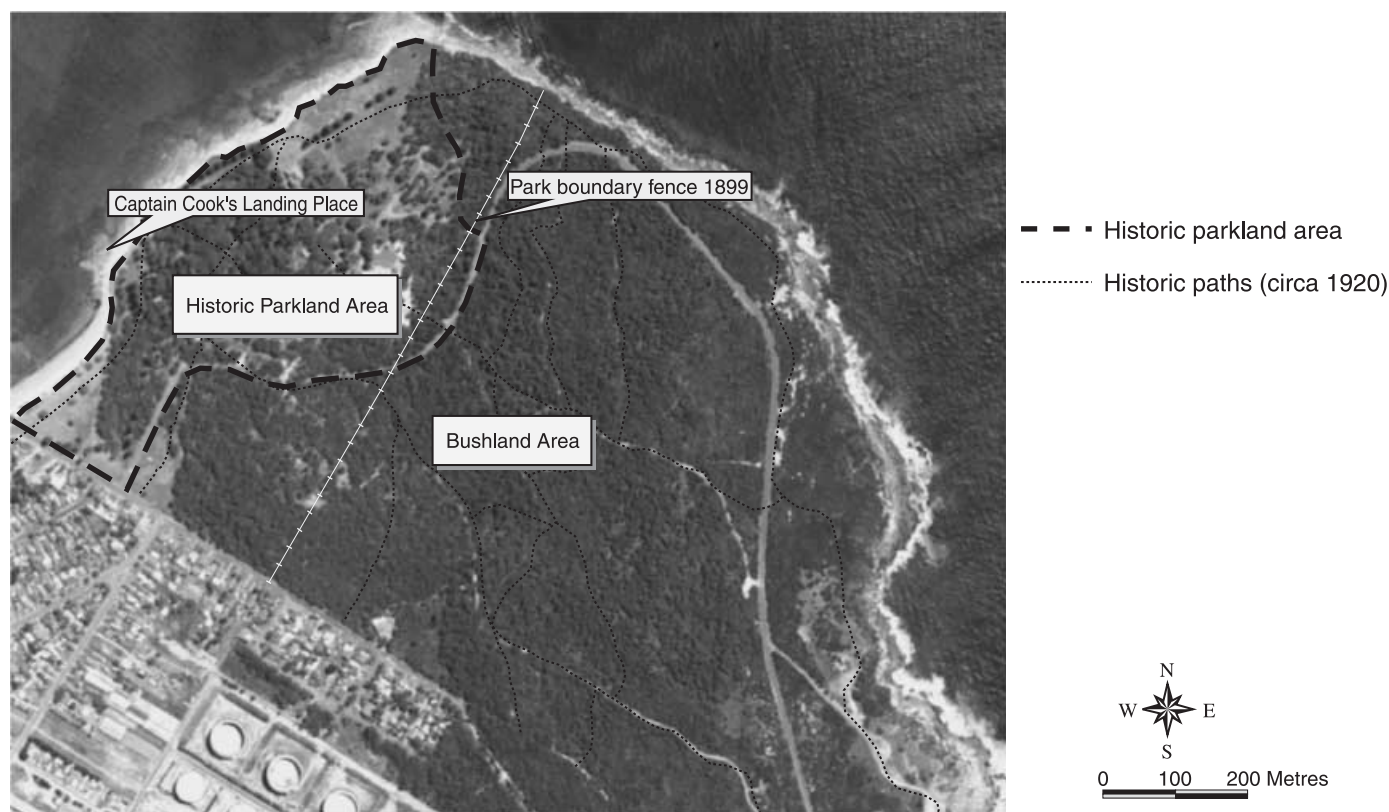


Figure 2. Approximately 20 ha of historic parkland and 100 ha of adjacent bushland were surveyed for the presence of Tallowwood and other non-local tree species.

a number of other non-local species, both native and exotic, have been planted at the site since the earliest recorded plantings in 1845 (Captain Cook's Landing Place Trust archives, unpubl. data). Remnants of the original *Banksia-Monotoca* (*Banksia integrifolia-Monotoca elliptica*) scrub noted on 19th century maps, however, still survive on a sandy knoll close to the Cook monument.

At first glance the dune and sandstone communities to the south of the landing place appear in good condition and largely free of introduced species. In stark contrast, mature Tallowwood (*Eucalyptus microcorys*) and other introduced trees are obvious in the cleared zones of the landing place area. Tallowwood occurs naturally in Queensland and the north coast of NSW (north of the Newcastle area) where it is an important timber tree (Chippendale 1988; Harden 1990–93). The species is not native to Kurnell but was widely planted in the landing site reserve in first half of the 20th century.

During a recent inspection of bushland adjacent to the cleared zones we noticed areas dense with Tallowwood saplings, evidently naturalizing from larger, planted trees on the bushland margins. Concern at the potential expansion of Tallowwood into this important conservation reserve prompted us to examine the extent of the species in the park and to propose guidelines for its management. At the same time the impacts of other planted non-local tree species were also recorded.

Survey of naturalizing species

Ground reconnaissance of the northern end of Botany Bay National Park was carried out in July 2004 to locate all individual trees of Tallowwood. The unexpected discovery of other non-native trees in otherwise undisturbed bushland led us to extend the survey to include Brush Box (*Lophostemon confertus*), Turpentine (*Syncarpia glomulifera*), Willow Myrtle (*Agonis*

flexuosa) and Cabbage Palm (*Livistona australis*). These species were often found located with Tallowwood trees. An area of approximately 100 ha was covered, including about 20 ha of grassed parkland surrounding the landing place and associated monuments, hereafter described as the 'historic parkland area' (Fig. 2), and 80 ha of adjacent natural bushland (Box 2). The southern area of the National Park was not surveyed as there is no record of planting occurring there (it was not under the control of the original Trust), no Tallowwood has been observed there and the habitat (generally coastal heath on sandstone) does not appear suitable for Tallowwood growth.

The location of specimens was recorded with a handheld GPS and subsequently plotted using ArcView. Each specimen was classified by its stem diameter into one of five classes, namely, less than 10 cm (class a), 10–20 cm (b), 20–30 cm (c), 40–70 cm (d) and greater than 70 cm (e). Cabbage Palms were classified according to trunk height, measured to the growing point.

Box 2. The site's native plant communities

On the sandhills that form a backdrop to the landing place there are remnants of Banksia-Monotoca (*Banksia integrifolia*-*Monotoca elliptica*) scrub. Now significantly reduced, this community would have been extensive on the foreshore sandhills at the time of Cook's visit.

To the south of the cleared zones of the landing site, the larger part of the National Park is relatively undisturbed eucalypt woodland and sclerophyllous scrub on sand dunes and Hawkesbury Sandstone.

Part of this vegetation, Kurnell Dune Forest, is listed as an Endangered Ecological Community under the *NSW Threatened Species Act, 1995*. This is a low open eucalypt forest community with a distinct mesophyll element found on the dunes at Kurnell. Characteristic tree species include Bangalay (*Eucalyptus botryoides*) and Sydney Red Gum (*Angophora costata*). Ground layer species include Aotus (*Aotus ericoides*), Old Man Banksia (*Banksia serrata*), Wombat Berry (*Eustrephus latifolius*), Coffee Bush (*Breynia oblongifolia*), Climbing Guinea Flower (*Hibbertia scandens*) and Muttonwood (*Rapanea variabilis*).

On the sandstone is coastal heath with a variety of shrubs including Heath Banksia (*Banksia ericifolia*), Mountain Devil (*Lambertia formosa*), Broad-leaf Drumsticks (*Isopogon anemonifolius*) and Coral Heath (*Epacris microphylla*). These communities are characterized by very low nutrient soils and naturally subject to periodic fire.

(Plant nomenclature follows Harden 1990–93).

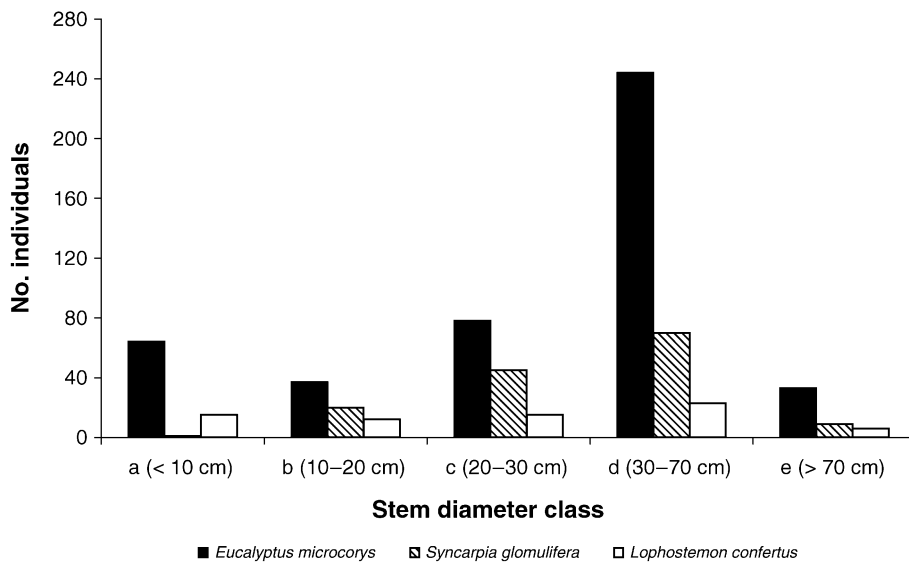


Figure 3. Distribution by stem diameter class of non-indigenous tree species; Tallowwood (*Eucalyptus microcorys*), Turpentine (*Syncarpia glomulifera*) and Brush Box (*Lophostemon confertus*) in Botany Bay National Park. Of the three species, Tallowwoods are present in the largest numbers both in mature specimens and sapling recruits.

Where specimens were multistemmed, the largest stem was classified. Stem diameters were measured at a stem height of 1.5 m. Because of their local high densities and time constraints not all small Tallowwood (stem diameter less than 10 cm) were recorded, however, the records were extrapolated to estimate the actual numbers of small Tallowwoods.

Results of the 2004 survey

The survey recorded 456 Tallowwoods, 145 Turpentines, 71 Brush Boxes and 30 Cabbage Palms (including 549 mature trees and 153 immature specimens). Tallowwoods and Turpentines were generally recorded growing together and occurred in distinct clusters. Brush Box

trees were found scattered throughout these same sites. Mature Cabbage Palms were restricted to four sites, close to, but not associated with, the other tree plantings. Willow Myrtle was the only other planted non-local native species consistently noted in the bushland, though much less frequently than the others.

Tallowwood tree diameters (Fig. 3) ranged from < 10 cm to > 70 cm with the largest diameter noted being 110 cm. The tallest of the Tallowwoods in the National Park reach approximately 30 m and the distribution is throughout the historic parkland area and in distinct clusters in the adjacent bushland areas (Fig. 4). Individuals in the 30–70 cm and > 70 cm diameter classes (d and e) appear to be original plantings, with many of these trees being located in the historic parkland area. Stems < 20 cm (classes a and b) appear to be self-sown recruits, while 20–30 cm stems (class c) may be either original plantings or self-sown recruits. The results suggest there are about 300 mature planted Tallowwoods in the National Park, and another 300–400 saplings established naturally from seed originating from planted trees. Seedling recruitment is patchy though in some bushland areas there are quite dense stands of self-sown Tallowwood saplings. In most of the bushland areas there is a very low presence of other weed species in association

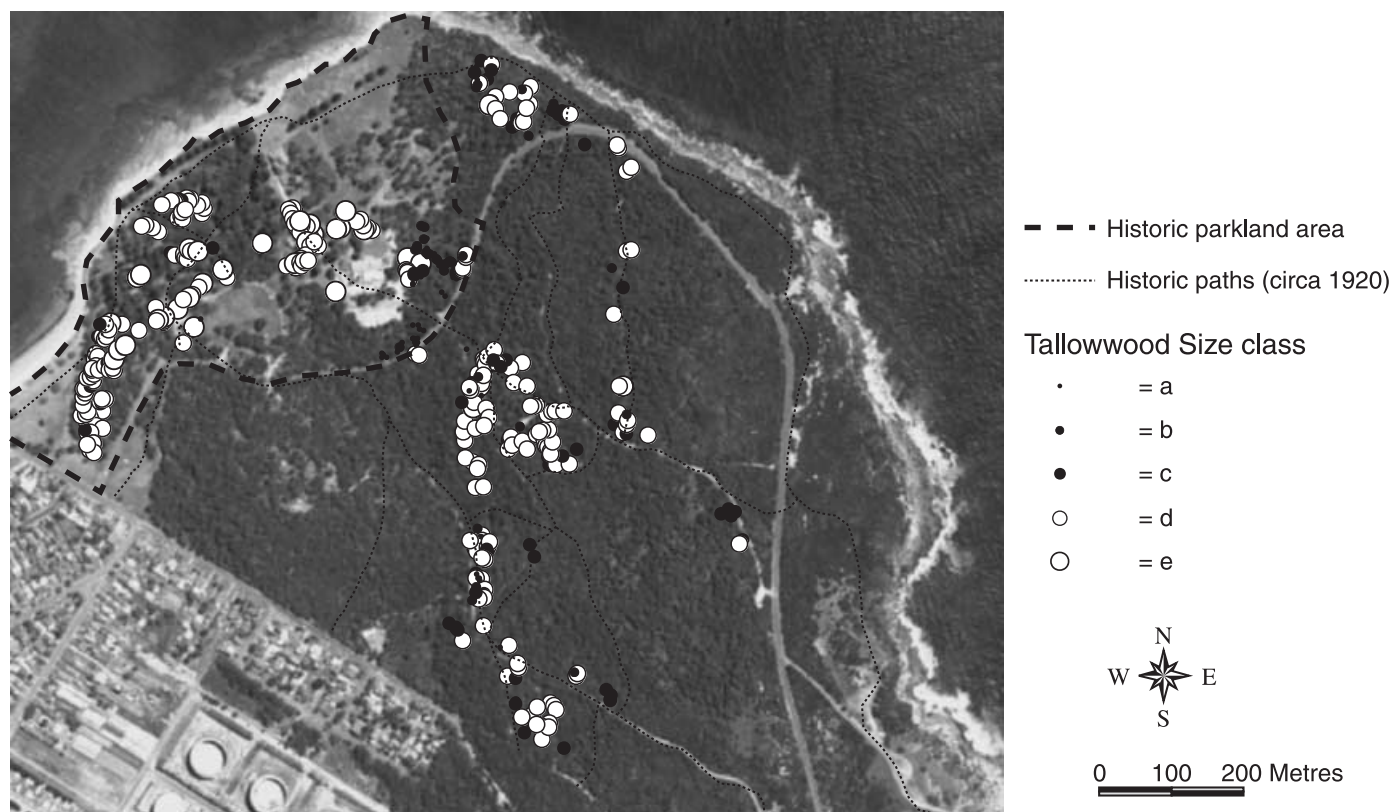


Figure 4. Distribution of Tallowwood in the National Park. Major planting areas were within the historic parkland and at various locations along the trails of the major dune, which runs north–south through the centre of the park.

with the Tallowwood. However, in the historic parkland area, in understorey that is not subject to mowing, there is intense competition from other weeds such as *Asparagus* (*Asparagus aethiopicus*).

Stem size may provide an indication of tree age for the Tallowwood. Historical records of the tree planting program indicate that the largest trees, with a current diameter of about 100 cm, could be about 80–90 years old and are unlikely to be more than 100 years. It is suggested that the trees with stem diameters around 40 cm could be about 40–50 years old. As the sandy soils at Kurnell are generally poorer than the gully soils of Tallowwood in their native habitats on the NSW North Coast, the growth rates would be expected to be lower than for naturally occurring populations.

Tree diameter classes for Brush Box (Fig. 3) range from < 10 cm to > 70 cm with the largest individual tree having a diameter of 105 cm. Individuals in the historic parkland area are generally single-stemmed with larger trunk sizes (up to

105 cm diameter) (Fig. 5). However, where the species occurs in bushland areas most of the original old trees no longer have a central main trunk, but have a circle of suckers around the base (commonly 8–12 suckers of 10–20 cm diameter). It is likely that these multi-stemmed individuals are regrowth from a rootstock after fire, and that at least 40 individuals and probably more are the result of planting. Some small stems that were noted could be seedling recruits. Brush Box seedlings have been noted to establish in bushland elsewhere around Sydney (e.g. northern end of Royal National Park and Mosman, D. Benson, pers obs, 2004).

Tree diameter classes for Turpentines (Fig. 3) range from 10 cm to > 70 cm (the largest individual was 98 cm), although only one individual was found in the smallest stem class (i.e. < 10 cm diameter). The mature Turpentines were found in both the historic parkland area and in the bushland areas (generally in association with Tallowwood). The absence of Turpentine seedlings may

be explained by the species preference for clay soils rather than the naturally sandy soils of Kurnell. Turpentines are generally slow growing trees and in areas with frequent fires become multi-stemmed, as post-fire recovery is often confined to suckering from the base. A number of the mature Turpentines in the bushland areas were found to be multi-stemmed, while those in the parkland areas, where fire has been largely excluded, were most commonly single-stemmed (NPWS 2001). The results of the survey suggest that most of the 144 Turpentines are the direct result of plantings (Fig. 6).

Mature Cabbage Palms (Fig. 5) were recorded in distinct clusters along creek lines and swamp margins and generally were not directly associated with the other plantings. The palms showed a big difference in trunk height between locations, but a total of 26 individuals with trunk heights of greater than 2 m (classes b, c and d) appear to represent original plantings. We remain uncertain as to the status of the palms. Cabbage Palms did occur naturally

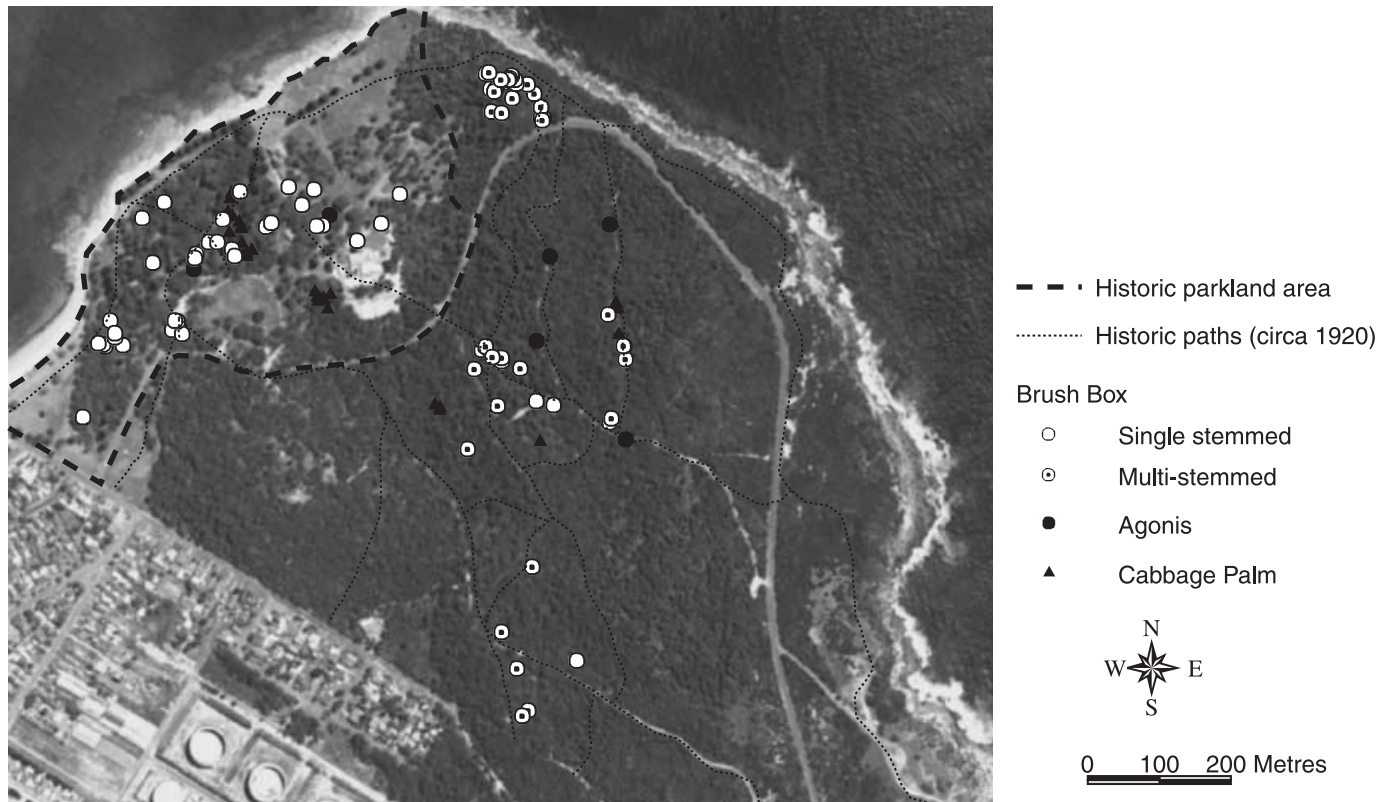


Figure 5. Brush Box, Cabbage Palm and Willow Myrtle distribution. In the bushland areas most Brush Box were found to be multi-stemmed, consistent with the species' fire response. However, the parkland areas (largely protected from fire) contained only single-stemmed individuals.

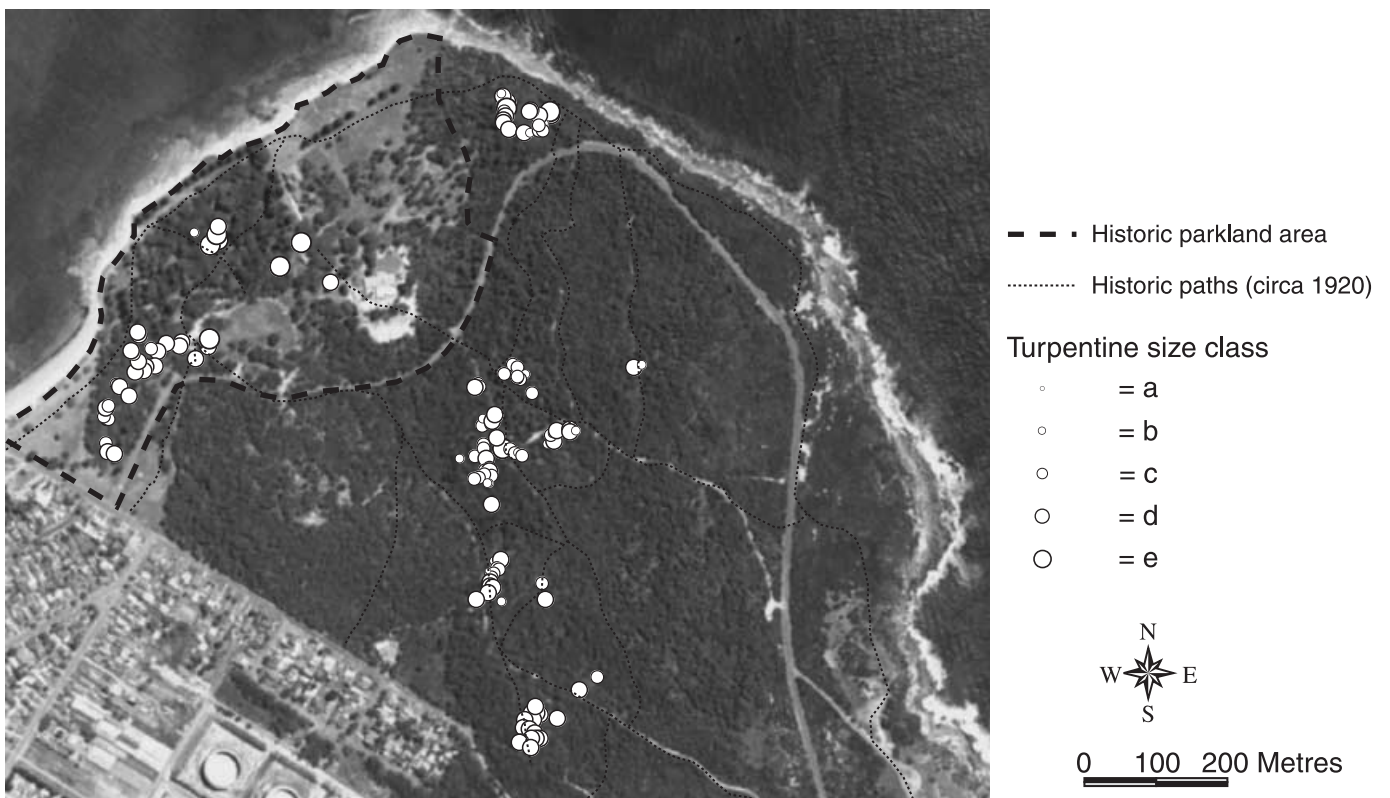


Figure 6. Turpentines were planted in the historic parkland area and in clusters along the walking trail system.



Figure 7. This site, on the bushland margins, shows a mature local *Angophora costata* at right, while nearly all of the saplings visible are Tallowwood.

near Botany Bay. Cook mentions in his Journal (1 May 1770) seeing palms with steps cut in them by Aboriginal people (Beaglehole 1968); however, it is not clear whether he saw them near the landing site or further inland. The plants we recorded do not appear to be part of a remnant natural population, as the sites appear to be drier and more open than we would expect; natural Cabbage Palm populations are found in littoral rainforest on moist rocky slopes (e.g. around Pittwater and in Royal National Park). So whether the palms at Kurnell are the result of past plantings, or natural seed recruitment from past plantings or from nearby garden plantings, or survivors from a remnant native population is unknown.

Impacts of Tallowwood and other plantings

Tallowwoods are now recruiting in otherwise weed-free bushland within Botany Bay National Park. Tallowwood has the capacity to dominate the generally low woodland structure of the natural vegetation. Individual canopies are dense, compared to other eucalypt species, and can cover areas

of 200–400 square metres. The shading, together with the root competition for moisture, may displace local native overstorey species, affect the composition of the native understorey and is likely to impact on associated bird and invertebrate populations.

The composition of the understorey beneath the Tallowwood canopy is variable at different locations within the reserve. A common observation however, is that the shrub layer is consistently limited, both in density and diversity when compared with neighbouring Sydney Red Gum and Swamp Mahogany dominated communities. Recruitment of trees beneath the Tallowwood canopy is variable. Under some groups of Tallowwood we see large numbers of established Tallowwood saplings, while under other groups, very few saplings. What is common in the Tallowwood understorey is a distinct absence of saplings of local tree species. Of particular concern is the impact of Tallowwood on the *Banksia integrifolia*-*Monotoca elliptica* scrub community, which has been greatly diminished by the effects of shading and competition from the Tallowwood. (Fig. 7)

In addition to the ecological impacts, visitor appreciation of the woodland vegetation is distorted by the presence of these patches of taller forest, while the clearly non-native identity of the Brush Box and Willow Myrtle is an affront to knowing bushwalkers. More importantly, from a scientific point of view, the native vegetation at Kurnell is a valuable indicator of the species that were present in the area prior to European impacts. In conjunction with the plant and animal collections of Banks and Solander, some of which are now held at the National Herbarium of New South Wales, and the journals of Cook and Banks, the site provides a unique window onto the landscape of pre-European Australia. However, to maintain these values the habitats must be kept free of non-native species.

Evolving management styles

In 1899 when the Captain Cook Landing Place Trust assumed management of the site, the management activities of the next 50 years would probably have been regarded as extremely progressive, indeed as 'best practice'. In light of the site's historic significance and the visible degradation, the Trust clearly saw that it had a responsibility to rehabilitate the degraded areas and make improvements in amenity and educational opportunities for the visiting public.

The early decision to use only Australian native species in the rehabilitation plantings would have been consistent with a feeling of nationhood engendered by Federation and may have been considered a fitting acknowledgement of the association of the place with James Cook and his botanist Joseph Banks. At the same time, however, the Trust's attitude to the existing natural vegetation of the site appears ambivalent (Captain Cook's Landing Place Trust annual reports, 1912–1967, unpubl. data.). Historical records suggest they felt a responsibility for protecting natural bushland so that city people could experience the bush at a location relatively accessible. Despite their desire to protect and enhance the bushland it seems they took little interest in, and acquired little knowledge of the ecology of the native plant species and communities under their care. The Trust regularly

reported on the spectacular flowering of native species a few years after fire, but at the same time they reported bushfires as being deleterious to the bush, and they continued to replant areas subject to fire. Grazing, drought, fire, flooding and storms constantly impacted planted trees and the loss of large planted specimens was always described as a more serious loss than the loss of naturally occurring individuals.

Like many of their era, the Trustees' perception was that forest vegetation was more desirable than low-growing vegetation. Since most of the Kurnell natural vegetation was low-growing woodland, scrub and heath, they sought to improve it by planting forest tree species. The planting program was a major component of vegetation management in the reserve for about 70 years but the longer term result has been unsatisfactory. With the change in management from the Captain Cook's Landing Place Trust to the National Parks & Wildlife Service in 1967, and the development of strategies aimed to conserve native biodiversity, the planting of non-local native species into bushland became recognized as a degrading process, and the planted individuals, and particularly their progeny, as weeds.

The only notable attempt by the Trust to foster a major local species was with the Coast Banksia (*Banksia integrifolia*). This species appears to have been an important part of the remnant native Banksia-Monotoca scrub originally occurring on the sandhills near the Cook monument. During the Trust's period of management this scrub continued to deteriorate as a result of continued grazing (cattle grazed under permit in the parkland area from 1901 till 1911) and, as it was largely protected from fire, there was little natural regeneration. The planting of Tallowwoods further diminished the Banksia-Monotoca scrub community by excessive shading of the groundlayer species. The Trust recognized the Coast Banksias were important, evidenced by their diligent recording of the loss of many natural Banksias, often in storms, and the planting of numerous replacements, but they were at a loss to know how to effectively protect them. As a consequence, the native Banksias in the landing place area, evident in late 19th cen-

tury sketches and photos of the site, are now virtually gone, though there are still some plants of the longer-lived Monotoca (*Monotoca elliptica*). What is left is a degraded natural plant community with a greatly increased canopy height (often 25–30 m vs the likely 3–8 m of the original Banksia-Monotoca community) and vastly different species composition to that likely to have been seen by Cook and Banks when they arrived in Botany Bay in 1770.

Protecting the Park from Tallowwood

Some of the Park's planted non-local trees, such as the foreshore pines, are accepted to be of cultural value. These trees are largely contained within the historic parkland area and can be managed so as to minimize or eliminate their impact on the ecological values of the reserve. However, where introduced trees are not of cultural value and they are threatening ecological values they should be controlled or eliminated (NPWS 2002; AABR 2005). A thorough assessment of all planted species is required to assess their potential impacts on the local native vegetation communities and any cultural values that exist.

Tallowwood, particularly in the bushland areas of the Park, is compromising the integrity of the native ecosystems. A strategy is now required for its control. The strategy will need to recognize that management of tree species in the historic parkland areas will require a different approach to that of the bushland areas. Further study is required to prioritize the areas for control and to develop site-specific methods for regeneration of areas where Tallowwood will be removed. Regeneration of the Banksia-Monotoca scrub may require the most intensive program as the community is severely degraded and healthy remnants are limited. At a minimum the rehabilitation programme in this community will require the removal of Tallowwoods, ongoing control of the ground exotics particularly Asparagus, the possible introduction of a fire regime and the propagation and planting (from local sources) of Coast Banksia and Monotoca. The regeneration pro-

gram may be less intensive in bushland areas where there is currently little competition from other weeds. The presence of cultural plantings within the National Park presents the park managers with an ongoing vegetation management challenge but at the same time it provides an opportunity to educate visitors not only about the history of the Park but about the potentially devastating relationship between introduced species and local native ecosystems.

Implications for the management of other bushland areas

The historical planting programs at Kurnell demonstrate the long-term effects that planting of non-local species can have. While non-local species may be considered acceptable in parklands, they are not appropriate in bushland areas. Considerable effort is often devoted to removing exotic species from bushland, however, the potential for native species that are not indigenous to particular bushland sites to alter sites and to affect local native species is rarely considered.

Elsewhere in the Sydney region, eucalypts that have been similarly adaptable are limited to Lemon Scented Gums (*Corymbia citriodora*) – e.g. at Rookwood, Beecroft, Summer Hill (D Benson, pers. obs., 2004), and possibly the Spotted Gum (*Corymbia maculata*). Other Myrtales planted and sporadically naturalizing outside their natural geographical range include Brush Box and Willow Myrtle. Native woody species other than Myrtales have also become troublesome weeds outside their natural distributions (e.g. Golden Wreath Wattle (*Acacia saligna*) and Cootamundra Wattle (*Acacia baileyana*)). Initially these species may be overlooked as the plants are often not recognized as weeds. Golden Wreath Wattle spread from roadside plantings into bushland in the Frenchs Forest area in the 1970s and was widely established before being recognized as a weed. Cootamundra Wattle is probably a less aggressive bush invader than Golden Wreath Wattle, but has an added environmental impact through genetic pollution by hybridizing with a range of related

species including the endangered Downy Wattle (*Acacia pubescens*) (Harden 2002).

Despite their potentially devastating impact on natural community structure, such as on the shrubby woodland at Kurnell, all native trees tend to be seen as 'good' (as opposed to the 'evil' exotics) and by the time a problem is recognized, the non-local trees may have become an established and accepted part of the landscape. There may then be opposition to their removal. To avoid this situation the first step is ensuring that non-local trees are not planted in bushland areas. In cases of historical plantings, such as at Kurnell, existing trees should be removed as soon as practicable, and before they produce seed. Removal programs will generally also require a strong community consultation and education strategy to ensure that ecological protection does not get derailed by community hostility.

While we now generally appreciate that planting non-native or non-local species into

conservation areas is inappropriate, the use of non-local provenance material in restoration plantings continues to occur. The lesson from the Tallowwoods at Kurnell is that well-meaning, but short-sighted rehabilitation actions may have long-term implications. Just as the Tallowwoods have gone largely unnoticed for decades and are now a relatively expensive issue to deal with, so might the introduction of non-local material of existing species become a long-term issue and cost. With the increasing use of DNA analyses, the need for maintaining unaltered reference populations and sites in conservation reserves is increasing. The use of non-local material, though well-meaning but often prompted by expediency, is another of the short-term but avoidable actions that continue to degrade bushland remnants.

Acknowledgements

The authors would like to thank Jocelyn Howell for assistance with fieldwork.

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