

Was *Phormium tenax* introduced to Norfolk Island by the Polynesians?

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Abstract: *Phormium tenax* (New Zealand Flax) is a large rhizomatous perennial herb with a natural distribution restricted to the southwest Pacific, primarily on the New Zealand islands. The species' extra-New Zealand distribution is confined to smaller islands to the north and east, namely the Chatham Islands, Raoul Island in the Kermadecs, Campbell Island, the Auckland Islands and Norfolk Island. The species may have been introduced to some of these islands.

The species has always been treated as indigenous to Norfolk Island (lat 29° 02'S; long 167° 57'E, 780 km north of New Zealand). Recently, it has been suggested the Polynesians may have introduced *Phormium tenax* to that island in the distant past. A review of the evidence for its indigenous and introduced status on Norfolk Island is presented, concluding that the evidence either way is inconclusive, but that the indigenous status of the species is completely feasible. Taxonomic and/or genetic studies, with comparisons to the taxa in New Zealand and elsewhere, would provide useful information on the status of the plants on Norfolk Island.

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Introduction

The large, clump-forming herbaceous plant *Phormium tenax* J.R. Forst & G. Forst. (variously placed in the Agavaceae, Phormiaceae or Hemerocallidaceae), generally known as New Zealand Flax because of its prevalence in that country, has always been treated as indigenous to Norfolk Island (e.g. Laing 1914, Fleming 1976, Green 1994). In addition to Norfolk Island the species is considered indigenous to the North and South Islands of New Zealand, Stewart and other offshore islands, and the Chatham Islands. It is usually considered to have been introduced to Raoul Island in the Kermadecs, Campbell Island and the Auckland Islands, either by Maori or early European whalers or sealers. The species is introduced to and is a significant pest species in some places, including Hawaii. Its numerous cultivars are widely known in the nursery industry around the world. Wehi and Clarkson (2007) provide a comprehensive review of all aspects of *Phormium tenax*.

Phormium tenax was named by the botanical duo, Johann Reinhold Forster and his son Georg, who accompanied James Cook on the *Resolution* on Cook's second Pacific expedition in 1772–1775. The origin of their type specimen is Queen Charlotte Sound in New Zealand, gathered there during that expedition. The Maori had long known of the plant and used it for a wide variety of purposes, ranging from

weaving, to cosmetics and raft making; the Maori name for Flax is *harakeke*.

Cook's report of abundant pines *Araucaria heterophylla* and Flax on Norfolk Island, both potentially very useful materials for the Royal Navy, prompted the European settlement of the island in 1788. The pines proved to be largely unsuitable for masts and spars, uses envisaged by Cook, because of the way the lateral branches are attached to the trunk, causing weakness in the timber. Although approached with high expectations, the exploitation of Flax on Norfolk Island was generally unsuccessful, despite several years of attempting to tease a useful product from its fibres.

Phormium tenax was common and grew densely around the cliffs of Norfolk Island in 1774, when James Cook made the European discovery of the island. In March 1788 during his early explorations of the island, Philip Gidley King, the first commandant on Norfolk Island, wrote, while climbing down the cliffs to Anson Bay, "we found our road must be down ye hill which is perpendicular & quite full of a large kind of Iris [Flax]" (Fidlon & Ryan 1980). King later noted in his report on the conditions on Norfolk Island dated 18 October 1796 that "flax needs no cultivation, as it grows sufficiently abundant on all the cliffs on the island ...".

Philip Gidley King instructed convicts to harvest the plant from natural occurrences and to prepare it to make cloth.

Their early attempts largely failed. King continued to believe in the possibility of a Flax industry on the island, but by 1791 was beginning to become despondent over efforts to successfully extract useable fibres. In his report of that year, King wrote that “every effort has been tryed to work it, but I much fear that until a native of New Zealand can be carried to Norfolk Island that the method of dressing that valuable commodity will not be known, and could that be obtained, I have no doubt but Norfolk Island would very soon cloath the inhabitants of New South Wales” (Historical Records of NSW, Vol. 1 Pt. 2, p. 429).

Two Maori men from the North Island of New Zealand were taken to Norfolk Island in 1793, but were of little help in the preparation of the Flax, as it was apparently women’s work. In the end, King’s optimistic report to Governor Phillip back in Sydney, subsequently passed on to Lord Sydney in London, was never realised: “the flax-plant will supply the settlers on that island [Norfolk] with rope and canvas, as well as a considerable part of their clothing” (HR NSW).

Ralph Clark, marooned on Norfolk Island for 11 months after the sinking of the *Sirius* in early 1790, observed the attempts to prepare the Flax but was apparently never as optimistic as commandant King. In his journal dated 31 August 1791, Clark writes that “about 35 men and about the Same number of women [are employed] in Cutting the flax to endeavour to bring it to perfection at Cascade Farm under a (Mr Hume) who was Sent her in one of the Ships that came here last by the Governor who Says that he understands it but for my own

part I doe not think that it will ever answer the expectations of Government I am no Judge therfor cannot Say they will or they will not” (Fidlon & Ryan 1981).

All in all, the original settlement of Norfolk Island, based almost entirely on some brief observations made by James Cook in 1774, turned out to be somewhat of a failure, at least as far as the value of the materials to be obtained was concerned. The original settlement, known as the First Convict Settlement, was abandoned in 1814.

Recently, there has been a suggestion that *Phormium tenax* was brought to Norfolk Island by Polynesians prior to its discovery there by Europeans in the late 18th Century (Macphail, Hope & Anderson 2001; Coyne 2009). This paper looks critically at the evidence for and against its human introduction to Norfolk Island.

Review of the Evidence

The paper by Macphail et al. (2001) challenges the long-held view of the indigenous nature of *Phormium tenax* on Norfolk Island. Analysing pollen obtained from the swamp at Kingston on Norfolk Island, the authors endeavoured to reconstruct the previous vegetation in the area. The authors state, probably correctly, that “the only treeless areas [on Norfolk Island] were the *Phormium tenax* covered sea cliffs”. The early records support the contention that Norfolk Island was largely covered in subtropical rainforest, with treeless areas only on the coastal cliffs around the edges of the island.

Macphail et al.’s contention that *Phormium* may not be indigenous is based entirely on the absence of *Phormium tenax* pollen in their swamp samples. One bore hole sequence was analysed for pollen, cored from the edge of Kingston swamp. No *Phormium tenax* pollen was found in any of the bore hole samples analysed, which date from the present to about 4,500 years BP. The authors state: “it is noted that what are interpreted as relatively dry edaphic conditions would be expected to favour the local establishment of *Phormium tenax* (nowhere recorded in the sequence) had the species been present on the island in Unit C time [i.e. c.1,000 years BP]”.

Why dry conditions would favour *Phormium* if it was introduced from New Zealand is unclear. In all of the books on the New Zealand flora consulted, it is stated that the species grows in swamp conditions. The Flora of New Zealand (Moore & Edgar 1970), for example, states that the species grows “especially in lowland swamps and intermittently flooded land”. Wehi and Clarkson (2007) note that the species is “a well recognised element of freshwater wetlands” and is “most commonly in freshwater wetlands”. Although intolerant of permanent deep water, *Phormium tenax* in New Zealand thrives in very wet soils, including swampy conditions. That it grows on dry, exposed sea cliffs around Norfolk Island, but possibly not in swamps, may in fact be indicating a distinct taxon.



PLATE 1.—NEW ZEALAND AND NORFOLK ISLAND FLAX-PLANT.
(PHORMIUM TENAX.)

Fig. 1. Drawing of *Phormium tenax*; reproduced from Historical Records of NSW Vol. 1, Part 2, Appendix B, page 707.

Macphail et al. (2001) continue: “Nevertheless, the complete absence of *Phormium tenax* (New Zealand Flax) pollen at a site known to have been within metres of a ridge described as being covered by this plant in A.D. 1774 is difficult to explain unless *Phormium* was introduced onto Norfolk Island by Polynesians sometime after c.1200 and before A.D. 1774. The data greatly strengthen the case that occurrences of New Zealand Flax elsewhere on small Southwest Pacific islands such as Raoul will be due to Polynesian occupation.”

The suggestion that the Kingston swamp is located metres from a ridge said, in 1774 (the year of Cook’s discovery of the island), to be covered in the plant is not consistent with the account at the time. Cook (quoted in Hoare 1969) mentions Flax being near his landing place at Duncombe Bay on the northern and opposite side of the island to Kingston. Cook’s ship did not go anywhere near the Kingston side of the island, as shown by the plot of the course of the *Resolution* by ship’s master Joseph Gilbert (Hoare 1969; Beaglehole 1969). Cook makes the following single mention of *Phormium* in his journal (Beaglehole 1969): “We found the Island uninhabited and near a kin to New Zealand, the Flax plant, many other Plants and Trees common to that country was found here ...”. The journal of William Wales, Astronomer on the *Resolution*, provides a bit more information on what was seen when they landed at Duncombe Bay (Beaglehole 1969): “Near the shores the Ground is covered so thick with the New Zealand flax-Plant that it is scarce possible to get through it ... a little way in-land the woods were perfectly clear and easy to walk in.” One suspects that the authors may have been referring to the comment by King as he landed for the first time at Slaughter Bay (Kingston) in 1788, rather than the writings of Cook: “above this beach lay a bank ye edge of which was surrounded by ye large kind of Iris [Flax]” (Fidlon & Ryan 1980). In any event, it is clear that Flax covered most of the coastal cliffs and ridges around Norfolk Island in 1774.

Norfolk Island shares about 33% of its indigenous flora of 182 species with New Zealand (Mills 2007). Much of the fauna, at least at the level of genus, is also shared between the two localities. In considering the distribution of several species of New Zealand origin among the islands of the south-western Pacific, Fleming (1976) writes that “the presence of the New Zealand monocotyledon *Phormium tenax* (Agavaceae) at Norfolk, the Chatham and Auckland Islands ... is almost an exact parallel to the three bird distributions” discussed in the paper. Wehi and Clarkson (2007) note that morphological differences in *Phormium tenax* have been identified from different geographical localities. This includes plants from the Chatham Islands (Greenwood 1992). Some of these taxa may in future be recognised as distinct. The Norfolk Island taxon has sometimes been considered as different, e.g. Department of Environment (Australia) web site lists it as *P. aff. tenax*. Green (1979), in a paper on the phytogeography of some Norfolk Island plants, made the following comment: “There is some undescribed differentiation which needs

investigation in *Phormium tenax* J.R. & G. Forst., the New Zealand Flax, which on Norfolk Island is confined to damp areas on cliffs and by the sea.” There is no mention of this differentiation in the flora of Norfolk Island (Green 1994), even though it was largely prepared by the same author.

Discussion

Peter Coyne (2009) suggests that Polynesians introduced *Phormium tenax* to Norfolk Island. Coyne’s contention is based on two pieces of information; firstly, the evidence from the above pollen study by Macphail et al. (2001), and secondly the assumed absence of the species from nearby Phillip Island (6 km south of Norfolk Island) at the time of European settlement (assumed because it was not reported from there by early observers). The question then, is whether this evidence is enough to conclude that *Phormium tenax* was introduced to Norfolk Island by Polynesians? It is contended here that the evidence presented by the authors of the above papers promoting the Polynesian introduction of *Phormium tenax* to Norfolk Island is not strong and is certainly not conclusive.

Palynological and taxonomic evidence

One fact that is inconsistent with the interpretations made of the pollen analysis is that even though *Phormium tenax* has been known to be on the island since before 1774, none of its pollen was found in the top (most recent) section of the bore hole core. It does not seem to be reasonable to then surmise that because *Phormium* pollen is not present lower down the core then it was not on the island. That the top section of the core was highly modified during European times should not matter, as this species was abundant on the island at the time.

The palynology literature for New Zealand reveals that *Phormium* seldom appears in pollen diagrams. This may seem incongruous given the abundance and widespread occurrence of *Phormium* in New Zealand but the reason is apparent in a statement by McGlone (2009) “other monocotyledonous pollen types are generally well represented in the pollen rain with the exception of Orchidaceae and *Phormium*, which despite bearing tall culms of large flowers, is rarely represented by more than a grain or two even when completely dominating a site.” The assertion by Macphail et al. (2001) that the absence of *Phormium* pollen from a single core in Kingston swamp proves that it was introduced to Norfolk Island by Polynesians about 800 years BP is, in this author’s view, a flawed conclusion. In their paper Macphail et al. refer to “bias caused by preferential destruction of less robust pollen types”, but do not discuss this issue in relation to the lack of *Phormium* pollen in their analyses.

Smitsen and Heenan (2007) found that plants of *Phormium tenax* on the Chatham Islands, well to the east of New

Zealand, are distinct in certain features when compared to the New Zealand material. They also found that a specimen of *Phormium tenax* from Norfolk Island was allied genetically to plants sampled from the North Island, Three Kings Islands, Poor Knights Islands and Chatham Islands, and that this group was distinct from specimens obtained from the South Island. This would be consistent with an indigenous status on Norfolk Island. The Polynesians did go to the Chatham Islands, but *Phormium tenax* from those islands is so distinct that there is no suggestion that it was introduced to those islands by Polynesians.

The natural occurrence of *Phormium tenax* on Norfolk Island is not inconsistent with the presence of that species on the Chatham Islands and proves that long distance oceanic dispersal of *Phormium* is possible. Both island groups are a long way from New Zealand; 780 km for Norfolk and 700 km for the Chathams, though the latter group is to the east of New Zealand making it easier for colonisation due to the prevailing weather systems. For Norfolk Island the Tasman Current and associated currents swirling anticlockwise around the Tasman Sea between Australia and New Zealand, may provide a long distance dispersal advantage. Sweeping up the west coast of New Zealand, the currents extend north towards Norfolk Island. Wehi and Clarkson (2007) note that seeds of *Phormium* float, and it is not beyond the bounds of possibility that seeds or other *Phormium* material capable of propagation reached Norfolk Island in the distant past via this current.

Given the above facts and the three million years that the Norfolk Island group has existed, it is not unreasonable to suggest that *Phormium* could have managed to get there. That Norfolk Island shares one third of its indigenous flora with New Zealand further strengthens this possibility. Clearly, over an extended period of time, plants can reach remote islands. Seeds can be blown by the wind, carried by birds and float across the ocean. Parts of plants capable of propagation can be floated long distances, perhaps attached to large trees or masses of vegetation washed into the sea during floods.

Polynesians did introduce bananas to Norfolk Island; these were found growing beside the creek at Arthur's Vale, not far inland from Kingston. Humans must have transported the sterile banana *Musa paradisiaca* to Norfolk. Vegetative propagation through dispersal of ramets from the most useful forms of *Phormium tenax* by Maori people has been well documented (e.g. Wehi & Clarkson 2007). There may be some relevance in that the Norfolk Island plants are said to be inferior for the purposes of weaving (M. Christian, pers. comm.). Archaeological evidence below the sand dunes behind Emily Bay at Kingston proves beyond doubt that Polynesians reached Norfolk Island. The way in which Polynesians used the island is still controversial, but it could have been on a seasonal or occasional basis; they apparently modified little of the environment of the island so were unlikely to have been long term inhabitants.

Phillip Island

On 2nd December 1788, King made a visit to Phillip Island and commented on its appearance: "*Most of the hills are covered with a thick entangled kind of reed which only wants burning to clear away 100 acres of ground, which would make a fine wheat land if not too dry.*" The 'reed' is almost certainly the sedge *Cyperus lucidus*. Today, this species is rapidly colonising many of the exposed slopes and ridges of the island following the eradication of rabbits in the 1980s (Mills 2009), and is likely to reflect the original vegetation cover of Phillip Island.

Even if *Phormium* was absent from Phillip Island in 1788, and this cannot be established beyond doubt, it does not necessarily provide evidence that the plant was introduced to Norfolk Island. There are numerous reasons why the species was not mentioned as occurring on or was originally absent from Phillip Island. *Phormium* may have gone unnoticed and/or un-reported by King and other early observers because it was only growing on the basalt dominated south-western corner of the island or perhaps it was not readily seen amongst the dense growth of *Cyperus lucidus*. If present, Flax was not likely to have been exploited on Phillip Island (and hence not mentioned as being there), because it was so abundant on Norfolk Island. Permanent habitation never happened on Phillip Island because of the lack of fresh water. On Phillip Island *Phormium* may simply have been too uncommon to attract comment.

The absence of any mention of *Phormium* on Phillip Island is tenuous evidence in favour of it not being there in 1788; it is even a more tenuous argument to then assume it was also absent from Norfolk Island. Few botanists went to that island and no one made an extensive list of the plants found there (Mills 2009), not even Allan Cunningham who visited in 1830 made a complete list. Since the removal of rabbits from Phillip Island 20 years ago, *Phormium* has colonised the same habitats there in which it grows on Norfolk Island, namely exposed sea cliffs.

Conclusion

At this point, we cannot be sure that *Phormium tenax* is indigenous to Norfolk Island. Hints that it may be indigenous include observations that the Norfolk Island plants are different in several ways to the New Zealand plants (Green 1979, M. Christian, pers. comm.). Secondly, *Phormium* grows in a quite distinct habitat on Norfolk Island, exposed coastal cliffs, that appears to be quite natural; it apparently does not grow in swampy conditions as it commonly does in New Zealand. Thirdly, it is said that the Norfolk Island plants are inferior for the purposes of weaving, so why would Polynesians introduce that form of the plant? That the species can successfully cross hundreds of kilometres of ocean and colonise remote islands is evidenced by its presence on the Chatham Islands.

On balance, I do not believe that the available evidence yet places us in a position to know conclusively one way or another whether *Phormium tenax* is indigenous on Norfolk Island. Plants may or may not have been brought to Norfolk Island by Polynesians; certainly, it was an important plant to their economy and culture. However, we need firm evidence of its introduction before it can be accepted as fact. On the available information, it seems more likely that *Phormium tenax* is indigenous to Norfolk Island. Detailed taxonomic and genetic studies may show the Norfolk Island plants to be different enough from those found in New Zealand to be taxonomically distinct and therefore most likely to be indigenous.

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