

TABLE 4: WORK PROGRAMME 1996

Date	Kaipara	East Coast	Te Urewera	Research
February			Check known sites/plants. Seed collection. Monitor plantings.	
March	Check for seeds. Monitor plants.	Seed collection. Check plantings.	Planting site selection.	
April				
May				
June		Planting.		
July	Site maintenance if necessary.			
August			Planting - ex situ.	
September		Check plantings.	Planting - wild. Monitor plantings.	
October		Fencing if required.		
November		Media release.		
December				

TABLE 5: WORK PROGRAMME 1997

Date	Kaipara	East Coast	Te Urewera	Research
February			Seed collection Monitor plantings.	Monitor tagged plants.
March	Check for seeds. Monitor plants.	Seed collection Monitor plantings.		
April				
May				
June		Planting.		
July				
August			Site maintenance if required.	
September		Check all sites (planted and natural.	Survey all sites. Update site report forms.	
October		Site maintenance if required. Media release.		
November				
December				

TABLE 6: WORK PROGRAMME 1998

Date	Kaipara	East Coast	Te Urewera	Research
			Seed collection Monitor new plantings.	
March		Seed collection Monitor plantings.		
April	Revise recovery plan.	Revise recovery plan.	Revise recovery plan.	
May				
June				
July				
August				
September				
October				
November				
December				

TABLE 7: PROJECTED STAFF TIME AND OPERATING COSTS OF THE RECOVERY PROGRAMME (FIELD COMPONENT ONLY)

	1993/94	1994/95	1995/96	1996/97	1997/98
East Coast					
(a) Staff days	10	4	4	4	
- conservancy	3	3			
- CAS	12	6	10	6	6
- field centre	25	13	14	10	6
Sub-total	1,800	1,800	2,500	1,200	1,200
(b) Operating Costs					
Te Urewera					
(a) Staff days	5	3			
- conservancy	4	3	3	2	3
- CAS	7	5	3	4	3
- field centre	16	11	6	6	6
Sub-total	2,500	1,200	1,200	1,100	250
(b) Operating Costs					
Kaipara					
(a) Staff days	1	1	1	1	1
- field centre	2	2			
- CAS					
Sub-total	100	100	100	100	100
(b) Operating Costs					
Totals					
(a) Staff days	44	27	21	17	13
(b) Operating	4,400	3,100	3,800	3,400	1,550

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Those people marked * above were members of a team formed to assist with preparation of this plan.

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TAXONOMY

Kowhai ngutukaka is a member of the pea family or Leguminosae (= Fabaceae), a very large family of herbs, shrubs and trees with a great variety of habit, including aquatics, xerophytes and climbers (Heywood, 1979). There are three subfamilies (or families) within the Leguminosae, and *Clianthus* is a member of the Papilionaceae. *Clianthus* belongs to a small and distinctive group of nine genera placed in Tribe Coluteae (Hutchinson, 1964). This tribe contains about 140 species of Asia, Africa and Australasia, with most belonging to *Swainsona* (55 species), *Lesertia* (50 species) and *Colutea* (25 species). The genus *Clianthus* is endemic to New Zealand.

The species level taxonomy of kowhai ngutukaka and application of scientific names at the scientific level has been the subject of some debate.

Kowhai Ngutukaka was first collected by Joseph Banks and Daniel Solander in October 1769 from Tolaga Bay and Tegadu (Anaura) Bay, north of Gisborne (Vickery pers comm to D. R. Given 1990). Solander gave the name *Clianthus puniceus* but his manuscript was never formally published. The first formal publication was as *Donia puniceus* by G. Don in 1832. Don noted that the species was first discovered by Banks and Solander but does not indicate whether he examined their specimens when drawing up his description. Subsequently, when Lindley (1835) resurrected Solander's name as *Donia* it had already been used and was therefore inadmissible.

Lindley clearly indicates that he used cultivated specimens in drawing up a description of the plant. Shortly after, the species was also described from cultivated specimens in Paxton's Magazine of Botany and Curtis's Botanical Magazine. Comparison of these three accounts suggests that material from the same source was used. This originated from seed collected by Richard Davis, an Anglican missionary who was active in Northland (Scholefield 1940). Thus early descriptions were made from two sources: Tolaga Bay and Anaura Bay between Gisborne and East Cape, and Northland. This provides an unresolved problem in typification which has consequences for formal recognition of entities within the species (or recognition of more than one species).

Colenso (1885) recognised two species; *Clianthus puniceus* and *C. maximus*, with *C. maximus* confined to the East Coast from East Cape southwards (the Urewera populations were not discussed separately). This separation was not accepted by Kirk (1899), Cheeseman (1925) or Allan (1961) who accorded Colenso's *C. maximus* varietal status only.

Wild kowhai ngutukaka is a variable plant. This variation has long been recognised, as illustrated by this extract from Cheeseman (1925):

"I agree with Mr Kirk in considering that Mr Colenso's *C. maximus* is not entitled to the rank of a species. Mr H. Hill informs me that in the East Cape localities the flowers vary considerably in colour, size, and in the shape and relative proportions of the petals. At Tolaga and Tokomaru the flowers are large, and the standard very broad, with a whitish stripe on each side near the base. At Waikaremoana the flowers are comparatively small and reddish-purple. A white-flowered variety is said by the Maori to grow on the Tiniroto Cliffs. Possibly this is the source of the white-flowered form sometimes grown in gardens, which I have proved to come true from seed."

There is even greater variation than recognised by Cheeseman. For example there is considerable variation between the Waikaremoana plants growing on different sites. On exposed sites plants are relatively low-growing and very capable of layering. Where more sheltered such as on lake shores, they are much more upright and can attain a very large size (and up to 3 metres high) but can collapse when they attain this size. One East Coast plant which was growing on a stream bank north of Tolaga Bay (washed away in cyclone Bola in 1988) was particularly upright with a single large trunk, but other extant East Coast plants are multi-stemmed and relatively low-growing.

The flowers of Waikaremoana plants can also exhibit the white stripes which Cheeseman notes for the East Coast plants. White striping of flowers sometimes occurs in cultivated plants.

PAST DISTRIBUTION

Kowhai ngutukaka may have been formerly far more widespread in eastern North Island. It probably formerly occurred extensively in the northern Hawke's Bay and Poverty Bay lowlands and coastal strip, from the Lake Tutira area to East Cape. Its inland limits are still partially defined by the present day occurrences in Te Urewera National Park.

Cheeseman (1925) lists many old records, extending from the Bay of Islands to Lake Waikaremoana. Even in 1925 Cheeseman made the following statement about its relative abundance: "Exceedingly rare and local in a wild state, and fast becoming extinct". He recorded it from the following localities, but noted that it had already disappeared from some of them: Taranaki Island (Colenso) and Motuarohia Island (Banks and Solander) in the Bay of Islands; Limestone Island and McLeod's Bay, Whangarei (R. Mair); Great Barrier Island (T. Kirk record 1867); Flat Island, near Howick (Cheeseman, not uncommon in 1878 but has been extinct for many years); Mercury Bay (A. Cunningham); near Thames (T. Kirk); Anaura Bay; Tolaga Bay (Banks and Solander); Motuoroi Island; East Cape Island; inland from Tolaga Bay; cliffs at Tokomaru Bay; Mangatokerau Gorge; Tiniroto; road to Morere; gorge near the Te Reinga Falls; and cliffs on Lake Waikaremoana. Cheeseman (1925) noted that it was still present on Motuoroi and East Cape Islands (Bishop Williams). Cheeseman (1925) also noted that the white-flowered form came from the Tiniroto cliffs ("A white-flowered variety is said by the Maoris to grow on the Tiniroto Cliffs. Possibly this is the source of the white-flowered form sometimes grown in gardens, which I have proved to come from seed.") Hybrids of intermediate colour have also been raised (Allan, 1961). White-flowered plants are also known to have occurred on the Te Reinga cliffs and at Hangaroa (J. Deans. pers. comm.). One of the Banks and Solander specimens at the British Museum (Natural History) is labelled "prope Tigadu [Anaura], Tolaga, Motuaro" (D.R. Given, pers. comm.). Cook's first voyage is known to have visited Motuaro in the Marlborough Sounds, however it is more likely that Motuaro is a misspelling of Motuoroi.

There are also records from "Heru-o-tureia" and "Awa-o-totara" on the Maungaharuru Range in northern Hawke's Bay (Guthrie-Smith, 1953). There is an unconfirmed report from inland of the Kaipara Harbour in the early 1970s (F.P. Hudson pers. comm.), and there are also records from Moturemu Island in Kaipara Harbour between 1930 and 1960, with seedlings common (F.P. Hudson, pers. comm.). A specimen collected from Moturemu by P. Hynes in 1953 is lodged in the Auckland Museum herbarium (AK 31510). It was presumed to have disappeared, but plants were rediscovered on the island in 1989 by a group of visiting botanists (F.P. Hudson pers. comm. and Cameron and Beard, 1990). There is some doubt as to the origins of the Northland plants. The Maori formerly cultivated kowhai ngutukaka (Allen, 1961) and dispersed the seed widely. It is possible that many or all of the Northland records were associated with human activity, and that they subsequently died out.

Taylor (1855) recorded that "This much admired shrub is only met with in the vicinity of old pas, and it is not improbable that it has been introduced. I received an account of a French vessel, which was captured many years ago in the Bay of Islands; the natives emptied many of the boxes on a small island in the Kerikeri River, which to their disappointment were only filled with seeds. It was remarked a few years afterwards the whole island was covered with

this shrub; its beauty attracted attention; its flowers were stuck in the ear as an ornament, the seed became sought after and was carried to every part." (Author's emphasis.)

It is possible that it is an introduction to Northland. If this was the case though it must have been moved there a very long time ago as there is a Banks and Solander specimen in Auckland dated 1769-70 on which there is a note that the species occurred in the Bay of Islands and East Cape district. This issue is also addressed in the section on Further Research Needs.

Taylor reinforced his suggestion that the species could have been introduced to New Zealand with the assertion that it was very different from other known New Zealand plants. Its presence in very inaccessible sites in the southern Urewera region is evidence for it not having been introduced to New Zealand, and it is unknown outside New Zealand as a native plant.

RESEARCH

Research has been carried out into various aspects of kowhai ngutukaka taxonomy, genetics and ecology.

(a) Research to Date

The earliest research on kowhai ngutukaka involved investigations into taxonomy by Colenso (1885), and for the floras of Kirk (1899), Cheeseman (1925) and Allan (1961).

Research into the basic ecology of the species started in 1986 at the Forest Research Institute (FRI) Rotorua (see Burns and Shaw, 1987; Shaw and Burns, in prep.). A complementary project was set up by DSIR Botany Division (now part of Landcare Research Ltd) to investigate the various provenances of kowhai ngutukaka. Seed for this project was supplied from the FRI field programme and from other sources.

The FRI project initially concentrated on investigating the basic ecology of the species. The original goal of this work was "to provide management agencies with the information and advice to ensure maintenance of kowhai ngutukaka in the wild". (B. R. Burns and W. B. Shaw funding application to New Zealand Lottery Board 1987). The objectives of this work were:

1. To describe and inter-relate population characteristics of known populations.
2. To establish permanent monitoring of selected populations.
3. To collect data on phenology, pollination, seed dispersal, seed viability, germination, seedling establishment, and genetics.
4. To make observations of animal damage (including birds and insects) and disease and to identify, wherever possible, the cause of such damage or disease.
5. To gather information on species distribution. All known wild plants were visited and detailed data collection carried out, including collection of soil and foliage samples for nutrient analyses.

The results of this work are contained in Burns and Shaw (1988) and Shaw and Burns (in prep.). Further research along the following lines started in late 1988:

1. Maintenance/manipulation of existing populations.
2. Planting trials on the East Coast mainland and on two islands.
3. Quantitative investigation of the genetic diversity and relationships of wild populations and cultivated plants.

Active manipulation (mainly pruning of competitors) of two Waikaremoana populations has been carried out as these were both being overtopped by woody competitors. Results appear very promising, with a positive response from the affected kowhai ngutukaka. The objective of the planting trials was to develop and refine techniques for re-establishing kowhai ngutukaka in self-sustaining wild populations. Results after one year are variable, with survival success ranging from 10 to nearly 100 percent. The

most significant conclusion that can be drawn to date is that the choice of sites for individual plants is absolutely critical. Sites must receive a high level of direct light and side-shelter is essential. Sites can be steep but small flat areas are preferred on steep slopes. Brown snails (*Helix aspersa*) can also be a severe threat and sites with large concentrations of snails should be avoided.

The genetics work is ongoing but has already proved very valuable. Given (1990b) lists three particular kinds of genetic information that are relevant to the management of threatened plant populations:

- (1) pattern of genetic diversity;
- (2) structure of local populations;
- (3) modes of reproduction.

All of these aspects have or are currently being investigated as part of a project that started as a joint MOF/FRI - DSIR investigation and is now being continued as a DOC - DSIR investigation. Seed has been collected from a range of wild and cultivated plants and seed proteins have been analysed using gel electrophoresis. Preliminary results have been very promising, with indications that we can identify differences between distinct populations such as the Waikaremoana and East Coast plants, and also between the separate Waikaremoana locations. Some cultivated plants were tested and found to be related to one Waipare plant. Some other related taxa were tested, and a relationship between *Clanthus formosus* and *Swainsona novaezealandiae* is suggested. This has been confirmed by a recent revision that includes *C. formosus* in *Swainsona*. This work is continuing, and will be written up separately.

Some germination trials have been carried out, to refine germination techniques and to investigate the relative viability of different seed stocks.

(b) Further Research Needs

There are a number of research needs outstanding at this stage:

- (a) The taxonomy and nomenclature of the taxa need to be resolved, to provide the basis for assigning management priorities. The provenance trials being carried out by Manaaki Whenua at Lincoln should continue, and will contribute to the resolution of taxonomic questions. Related work on the genetic variations in the populations, using gel electrophoresis of seeds, is continuing at DSIR Palmerston North, using samples supplied by the author. This will study the genetic relationships of the Te Urewera populations, the degree of variation and relationships in the East Coast population, whether or not the Moturemu Island plants are closely related to either the Urewera or East Coast plants and the origins and degree of variation in cultivated plants. Foliage samples will also be analysed using a DNA probe, for comparison with gel electrophoresis analyses.
- (b) The potential for long term seed storage needs to be assessed.

- (c) Planting trials need to be continued, to refine techniques for establishing new populations, or extending existing populations. An attempt could be made to use artificial layering techniques at Waikaremoana to extend existing populations. Creation of new habitat may be required in the long term.
- (d) Existing intensive monitoring of selected individual plants and populations at Waikaremoana should be continued.
- (e) More information is required on sexual reproduction strategies, and success, and the relative roles of different pollination mechanisms.
- (f) Seed dispersal may be by wind, water, or gravity. Further minor research could be carried out in this area, for example, to examine the role of wind in the dispersal of pods and seeds.
- (g) Predation of seeds and seedlings by rats and/or mice is hypothesized. Some work could be carried out in this area to elucidate their roles. Also work on susceptibility to snail predation, especially of the different genotypes. The effects of indigenous slugs and snails should also be considered.

Appendix 4

COLLECTION AND PLANTING GUIDELINES**(a) Collection Guidelines**

Collections of seed and/or cuttings must not endanger source plants or populations. Seed collection will be restricted to a maximum of 30 per cent of the viable seeds in any one year unless there are few viable seeds. If the population is severely endangered, up to 100 per cent of viable seeds could be harvested. Cutting removal should not threaten the survival of the branches or the plant that material is collected from.

(b) Planting Guidelines

- (i) Careful inspections will be mandatory when moving nursery stock to wildland sites to avoid carrying unwanted pests or disease. For example, it would be very easy to unwittingly translocate introduced brown snails. Any diseased or unhealthy plants should not be used in planting programmes.
- (ii) Planting operations will use only source material collected from wild plants, or from cultivated plants of known wild origin not growing in close proximity to other plants of different provenance. Cultivated plants of unknown origin will not be used as the source of planting material for wild sites.
- (iii) Material propagated from wild plants will only be reintroduced to wildland habitats or to similar sites or in the same ecological district from which the original collection(s) were made.
- (iv) Very careful consideration will be given to the selection of suitable wildland sites. Potential sites must have the following characteristics: good direct light; side shelter (preferably flax); suitable microtopography (preferably a small flat area where plants are to be placed); protection from or absence of problem pests.
- (v) Planting should only be carried out over the winter, preferably early winter. The exact time of planting will vary considerably for different areas. For example, East Coast sites should be planted in early winter to allow time for plants to establish good root systems before summer droughts start. Urewera sites should be planted in late winter or spring to minimise the risks of severe frost or snow damage. Adequate time should be allowed for "hardening off" nursery stock before they are planted.
- (vi) Wherever possible, mixed-age populations should be established. To achieve this, planting will need to be carried out over a number of years on any site.
- (vii) Layering may be a viable technique for maintaining or extending some existing populations.

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