T. F. Cheeseman Symposium

and

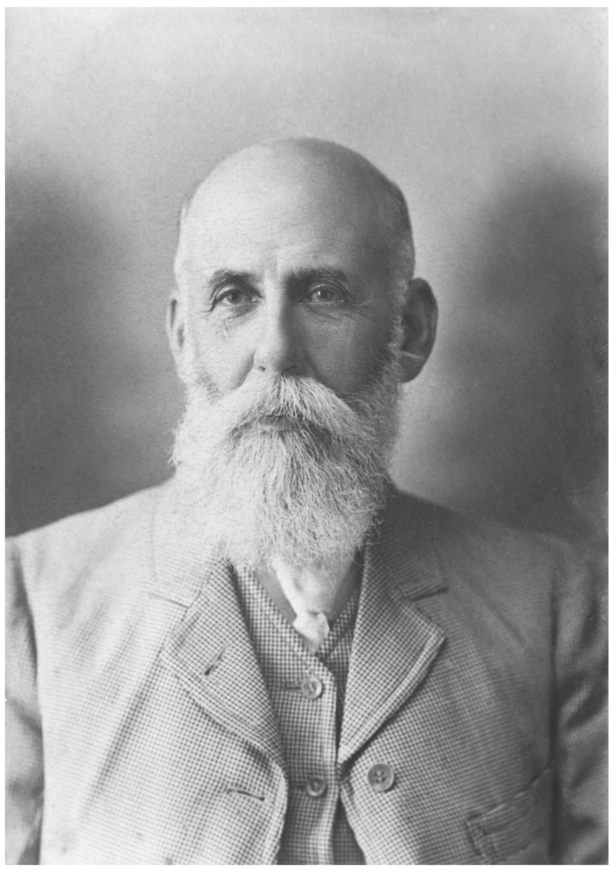
New Zealand Plant Conservation Network Annual Conference

University of Auckland

20-22 November 2006

Programme and Abstracts

celebrating 100 years
since the publication of
"*Manual of the New Zealand Flora*"



Organised by Auckland Botanical Society, Auckland Museum, Landcare Research, New Zealand Plant Conservation Network

Monday 20 November

Time	Cheeseman Symposium	NZPCN meetings
9.30-9.40	**Conference opening and welcome by Rodney Wilson, Director of the Auckland Museum**	
	Early botanists (Chairperson Brian Murray)	
9.40-10.10	*Keynote speaker. Ewen Cameron: Thomas Frederick Cheeseman FLS, FZS, FNZI (1845-1923)*	
10.10-10.30	I. St George: William Hodges's watercolours of plants	
10.30-10.55	**Morning tea**	
10.55-11.15	E. J. Godley: AFW Schimper and TF Cheeseman, biogeographers of the southern cold temperate zone	
11.15-11.35	D. Galloway: William Lauder Lindsay's contribution to cryptogamic botany in New Zealand	
	New Zealand floras and bioinformatics (Chairperson Brian Murray)	
11.35-12.05	*Keynote speaker. Aaron Wilton: Floras of the future*	
12.05-12.25	P. J. de Lange: Toward a full Chatham Island vascular flora	
12.25-12.45	D. Glenny: The New Zealand Liverwort flora	
12.45-1.05	C. Howell: The exotic vascular flora of New Zealand	
1.05-2.00	**Lunch** [NZPCN AGM]	
	New Zealand flora systematics (Chairperson Ilse Breitwieser)	
2.00-2.30	*Keynote speaker. Rob Smissen: Using molecular genetics to address taxonomic questions: new methods, old problems*	
2.30-2.50	R. Taskova: Chemical systematics and evolution of *Veronica*	**Time: 2.30-3.30** Landcare Research website tutorial
2.50-3.10	B. S. Parris: Grammitidaceae of New Zealand and the world	
3.10-3.30	P. J. de Lange: Biosystematics of the *Kunzea ericoides* complex	
3.30-3.55	**Afternoon tea**	
	Pollination and reproductive biology (Chairperson Pat Brownsey)	
3.55-4.25	*Keynote address. Linda Newstrom-Lloyd: Pollination systems in New Zealand*	
4.25-4.45	P. J. Garnock-Jones: Combined vs separate sexes in the land plant clade	**Time: 4.25-5.25** NZPCN website tutorial
4.45-5.05	A. Holzapfel: Hermaphrodites, sex distribution and sex determination in *Dactylanthus taylorii*	
5.05-5.25	S. H. Anderson: Widespread failure of bird-pollination mutualisms on the New Zealand mainland	
5.50	Bus departs for Auckland Botanic Gardens	
6.45	Auckland Botanical Society Function – Dinner at Auckland Botanic Gardens	

Tuesday 21 November

Time	Cheeseman Symposium	NZPCN meetings
8.45-8.50	Welcome and housekeeping	
	Science, conservation, and conservation management (Chairperson Ian Spellerberg)	
8.50-9.20	*Keynote speaker. Andrew Young: From Pattern to Process: Ecological and genetic approaches to the analysis of plant population viability*	
9.20-9.40	J. Collins: From Science to Community - The Conservation of *Atriplex hollowayi*	
9.40-10.00	D. Norton: Plant conservation in the South Islands high country – challenges and opportunities	
10.00-10.20	P. Knightbridge: Hope for mistletoe	
10.20-10.45	**Morning tea**	
10.45-11.05	J. Beever: From flora systematics to conservation, a rocky road – case studies from the moss world	
11.05-11.25	G. Jenks: Back to the future: the incredible functional and aesthetic superiority of NZ's native dune plants	
11.25-11.45	M. Piripi: Conservation and hybridisation in the Waimakariri Basin	
11.45-12.00	A. Townsend: New Zealand threatened plant listing announcement	
12.00-12.40	**Lunch**	
	Plant morphology, cytology, and function (Chairperson Phil Garnock-Jones)	
12.40-1.10	*Keynote speaker. Brian Murray: Why chromosomes still count.*	
1.10-1.30	P. Novis: Extremophilic algae: a selection from New Zealand, Antarctica, and North America	**Time: 1.10-2.10** Plant Conservation and Education. Sioux Cambell
1.30-1.50	J. Salter: Matai and miro - the inside story on the rumour of their separation	
1.50-2.10	M. I. Dawson: Chromosome relationships of the New Zealand and Australian Orchidaceae; independent evidence for the recent generic recircumscriptions	

Tuesday 21 November (cont.)

	Plant phylogeny and biogeography (Chairperson Peter Lockhart)	
2.10-2.30	*Keynote speaker. Leon Perrie: Phylogenetics, Taxonomy, and Biogeography*	**Time: 2.30-3.10** NZPCN website tutorial
2.30-2.50	K. Ford: Origin and biogeography of New Zealand *Craspedia* (Compositae: Gnaphalieae)	
2.50-3.10	R. Carter: Phylogenetics and ecology in the study of alpine plant evolution and distribution: a case study of New Zealand alpine *Ranunculus*	
3.10-3.35	**Afternoon tea**	
3.35-3.55	H. Meudt: Phylogeography of *Ourisia* (Plantaginaceae): an integrated study of a New Zealand alpine radiation	**Time: 3.35-5.15** Plant propagation workshop. Oratia Native Plant Nursery
3.55-4.15	M. Knapp: New Zealand plant phylogeography: the riddle of the “Beech Gaps”	
4.15-4.35	N. Lorimer: The biological complexity of New Zealand *Epilobium* L. (Onagraceae)	
4.35-4.55	L. D. Shepherd: Polyploid evolution of New Zealand *Asplenium*: new insights from chloroplast and nuclear DNA markers	
4.55-5.15	R. C. Gardner: A land of recent immigrants - stories from plant DNA sequences	
5.45-6.30	Auckland Museum: Wine & Cheese and T. F. Cheeseman Historic Display	
6.30	NZPCN Conservation Awards 2006 (Ian Spellerberg, MC); Allan Mere 2006 (Anthony Wright, MC)	
7.30	Audrey Eagle Book Launch (Angela Radford, Te Papa Press; Dr Brian Molloy)	

Wednesday 22 November

Field trips

Rangitoto Island. Depart at 9.15 am from the main Fuller's ferry terminal, returning at c. 4:00 pm.

Oratia Native Plant Nursery and Waitakere rarities. This trip will visit Oratia Native Plant Nursery for a practical demonstration of plant propagation techniques and to view an extensive native plant collection including many threatened species. From there, we will examine the Waitakere Ranges flora, investigating populations of several local rarities and discussing their management.

Early botanists

Keynote speaker

Thomas Frederick Cheeseman FLS, FZS, FNZI (1845-1923)

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Thomas Cheeseman was born in England; the eldest of five children. The family immigrated to Auckland when he was eight years old and at school he developed an interest in botany and geology. In his younger years he taught botany, zoology, even art, and had a strong interest in astronomy. He married Rosetta Keesing in 1889 and they had two children, Dorothy and Guy.

Cheeseman held the posts of Secretary of the Auckland Institute and Curator (i.e. Director) of the Auckland Museum for nearly 50 years (1874-1923). He was primarily a botanist, one of New Zealand's greatest, and the first with a New Zealand education. During his career, Cheeseman described four plant genera, some 154 species and 87 varieties of plants; a genus and 10 species of marine molluscs and two marine flatworms. Thirty-two plants from New Zealand and the Cook Islands and four New Zealand molluscs were named after him. He published the *Manual of the New Zealand Flora* (1906, 2nd ed. 1925) and *Illustrations of the New Zealand Flora* (1914), as well as 99 scientific articles, primarily on botany, but also including zoology and ethnology. Among his accolades he was elected Fellow of the Linnean Society and received their prestigious gold medal.

His fieldwork took him to many remote areas of New Zealand. He made notable collections from Kermadec Islands south to the Mt Cook district and published *The Flora of Rarotonga* (1903), his only overseas work. Of his herbarium of some 21,000 specimens near a third were collected by Cheeseman himself, a third by other New Zealand botanists, and a third were from overseas exchanges. He was an industrious worker, prolific correspondent and a cautious taxonomist – more of a 'lumper' than a 'splitter'.

William Hodges's watercolours of plants

Ian St George
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Hodges was the landscape artist for Cook's second voyage on the Resolution, but he helped George Forster with natural history subjects. A booklet of botanical sketches of Pacific plants (several from New Zealand) attributed to Hodges is among the treasures in the Alexander Turnbull Library in Wellington. This presentation traces the provenance of the booklet, the origin of the plants depicted, and the fate of the work in England after the return home. The effect of celebrity status on the young Hodges has some parallels with the similar experiences of unprepared popstars today.

AFW Schimper and TF Cheeseman, biogeographers of the southern cold temperate zone

E. J. Godley
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In 1907 the Canterbury Philosophical Institute sent a scientific expedition to the Auckland and Campbell islands; but T. F. Cheeseman was only invited to join the Campbell Island party, although by then, he was New Zealand's leading botanist. When his request to transfer to the larger and more biologically diverse Auckland Island was unsuccessful Cheeseman withdrew his name. Fortunately, however, he agreed to help with writing up the results of the expedition and in 1909 his paper "On the Systematic Botany of the Islands of the south of New Zealand" appeared in the 2-volume "The Subantarctic Islands of New Zealand." The last section of this paper is entitled "Affinities of the flora; with suggestions as to its previous history." In this section Cheeseman was influenced by the writing of the brilliant young German botanist Andreas Franz Wilhelm Schimper (1856-1901) who sailed on the *S. S. Valdivia* as botanist to the German Deep-Sea Expedition (1898-99) and spent 4 days on isolated Kerguelen Island, south of the Indian Ocean. Schimper caught malaria on the Cameroon coast during the expedition and died of it in September 1901. Thus the expeditions' botanical report did not appear until 1905. It was edited by Heinrich Schenck who included an essay left by Schimper on the history of the Kerguelen flora. Schimper's new idea was that the endemic genera *Pringlea* and *Lyallia* were relics of a pre-glacial flora and that the other species were post-glacial immigrants bought by ocean-going birds or wind. Cheeseman applied these ideas to our southern islands with *Pleurophyllum* and *Stilbocarpa* as pre-glacial relics. Both papers will be discussed in more detail with Schimper's paper illustrated by translated extracts.

"...to publish fragmentarily and occasionally,...": William Lauder Lindsay's contribution to Cryptogamic Botany in New Zealand

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Lauder Lindsay came to Otago in 1861 with two great advantages. He was a recent MD graduate of the University of Edinburgh (1852) where he had distinguished himself as an extremely hard-working student, and where he obtained the highest honours (three stars) for his thesis on "The Lichens: comprising their Anatomy, Organopgraphy and Physiology; Taxonomy and Classification; Geographical Distribution; and Utility". From this he published in 1856, a notable introductory text book on lichens, "A Popular History of British Lichens" beautifully illustrated with his own drawings. The "hard" science following on from his thesis work, was an extensive monograph on the pycnidia of lichens that won for him the foundation Neill Prize of the Royal Society of Edinburgh and, in 1861, his election to its Fellowship, a year before James Hector. He arrived in Dunedin as one of Scotland brightest rising botanical stars, to take stock of his second great advantage, a virgin botanical field, virtually unstudied and awaiting the attention of a collector and scientist of his calibre and abilities.Although limited by time and by facilities for travel to distant parts, Lindsay nevertheless made highly significant collections from the environs of Dunedin, right across the botanical spectrum: from marine algae, diatoms, freshwater algae, fungi, and lichens, to bryophytes, ferns and flowering plants. On his return to Scotland Lindsay enlisted the help of a range of experts to help him with the identification of his considerable collections. Having in mind the eventual publication of a detailed "Florula of Otago", his collections and the resulting publications that flowed from an examination of them between 1862 and 1868, were unfortunately overshadowed by the publication of J.D.Hooker's Handbook of the New Zealand Flora, a work commissioned by the NZ Government and which occupied Hooker between 1862 and 1867. Hooker's subsequent tart dismissal of Lindsay's botanical writings as "potterings" is both unthinking and unjust. Lindsay's place in the history of the botanical exploration of New Zealand is now re-examined, and his contributions to knowledge of Cryptogamic Botany in southern New Zealand is assessed. Both are secure and major components of New Zealand's "Colonial Botany".

New Zealand floras and bioinformatics

Keynote speaker

Floras of the Future

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Floras provide the basic reference for a specified region and group of plants. They are a comprehensive and authoritative reference that is a critical resource for biodiversity and biosecurity management, researchers, and botanical enthusiasts. Floras provide the basis for many other information products – including popular books and species profiles.

The production of a Flora continues to be a highly skilled and time consuming process; and results in a product that goes out of date yet is time-consuming to update, and must be reprocessed for many audiences. Modern information systems now provide opportunities to create the next generation of Floras in a more dynamic way. These information systems have the potential to unlock the wealth of data within a Flora, benefiting users by ensuring they have timely access to up-to-date data, and that the information products are tailored to their needs.

Toward a full Chatham Island Vascular Flora

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John W. D. Sawyer, Peter B. Heenan, Bill R. Sykes, Brian P. J. Molloy

The Chatham Islands are arguably New Zealand's most remote settled archipelago. Although the unique character of the Chatham Island flora has long been known, following von Mueller's 1864 singular and remarkable publication of a vascular flora for the islands there has been no full update. Since 1996 we have been compiling data for a future publication treating the vascular flora of the Chathams. In 1999 the first step toward that goal was the publication of a checklist of the indigenous vascular flora of the islands. We are now in the process of finishing a second revision which covers all vascular plants naturalised or indigenous to the islands. From that revision we now recognise 746 taxa from the islands. These are spread over 102 families and 349 genera. While there are no endemic families, 36 families are represented on the Chathams only by indigenous taxa. There are two monotypic, endemic genera, *Embergeria* Boulos and *Myosotidium* Hook. and 35 taxa are endemic species, subspecies or varieties. A further 11 entities appear to be undescribed and probably endemic to the islands. There are 421 taxa which we regard as indigenous, 307 as naturalised from outside New Zealand, and a further 19 are "mainland" indigenous New Zealand taxa that have become naturalised on the Chatham. A further two hybrid combinations involving these "mainland" New Zealand taxa and Chatham Island endemics are recognised. One species disjunction between the Chatham Islands and Australian is recognised. Of the 307 naturalised non-New Zealand taxa, most have established from past agricultural introductions but increasingly cultivation escapes are becoming the source of more worrying naturalisations. In this paper we discuss the need for a full flora treatment of the islands arguing that it would greatly assist the Chatham Islanders and wider New Zealand public in understanding the importance of these islands to global biodiversity and determine conservation priorities. We stress the need for the islanders to develop their own biosecurity system to minimise further plant/animal naturalizations and argue that a Chatham Island flora is one powerfully passive means towards empowering these people to decide their own conservation priorities.

The New Zealand Liverwort flora

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A liverwort flora for New Zealand is in preparation, and the first of three volumes is completed and has been submitted to the publisher, Missouri Botanic Gardens. This volume describes a third of the 600 species. When the three volumes are completed it will be the first modern liverwort flora for a Southern Hemisphere region. Volume 1 has 177 figures, 97 images in 16 colour plates, a glossary, bibliography, and an introduction that discusses the history of taxonomy and collections, the biogeography and ecology of the flora. The volume will be put online 12 months after it is published.

The exotic vascular flora of New Zealand

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Exotic plants are now so much a part of the New Zealand landscape that some visitors are astonished to learn that *Pinus radiata* is not native. Such common species are only part of a very long, and rapidly increasing list. The wild flora of New Zealand has doubled in less than two centuries, a direct result of European colonisation. The list discussed here is not compiled directly from herbarium specimens, rather is limited to only those taxa that have been published as adventive. Including plants established only as garden discards and cultivation escapes is essential as almost all naturalisation events begin with such marginal establishment. Simple analysis of the rate of discovery indicates that the rate is increasing. The naturalisation rate itself is unobservable. However, by modelling the effects of search effort and the discovery process, it is possible to make realistic estimates of the naturalisation rate. This then enables estimates of the lag between naturalisation and discovery, and the number of undiscovered naturalised plants.

New Zealand flora systematics

Keynote speaker

Using molecular genetics to address taxonomic questions: new methods, old problems

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Phylogenetic analyses, particularly those using DNA sequences, have brought unquestionable advances in our understanding of the broad scale relationships between plants. However, within many species groups DNA sequencing studies produce uninformative results, or eccentric results that raise more questions than they answer. Integrating molecular genetic techniques into lower level taxonomy therefore requires a careful and holistic approach. Using examples from a diverse group of angiosperms (*Asteraceae*, *Crassula*, *Lepidium*, and *Phormium*) I will argue that breeding biology and perhaps even the biological species concept need to be central to our approach to floral systematics in the genomic age.

Chemical systematics and evolution of *Veronica*

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Chemosystematics is classification of organisms based on differences at the biochemical level. A group of plant chemical constituents, the iridoids, attracts considerable scientific interest because of their biological activity and usefulness for chemotaxonomic purposes. Iridoid composition of European *Veronica* has been extensively studied but data for Southern Hemisphere representatives are scarce. Recent investigations on *Veronica*, conducted in labs in New Zealand and Denmark, revealed close relationships between the Southern and Northern Hemisphere groups and the main trends in chemical evolution of the genus. In my presentation I will discuss the iridoid markers in New Zealand representatives of *Veronica* (sect. *Hebe*) and their chemotaxonomic and evolutionary implications.

Grammitidaceae of New Zealand and the world

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The Grammitidaceae is a medium-sized fern family of at least 750 species, most of which are epiphytes of tropical montane forest. There are two major centres of diversity, one in the American tropics, with c. 250 species, and one centred in the Malesian tropics, with c. 500 species. An Austral, largely temperate, group occurs in Africa, Australia, New Zealand and southern South America, with 12 species in New Zealand.

Recent rbcL and atpB studies of 73 species of Grammitidaceae have recognised 10 clades, four in the Old World and six in the New World. The five New Zealand species sampled are included in a single clade, together with two New Caledonian species.

The clades will be discussed with respect to currently accepted taxonomy (revision badly needed), morphology (traditional taxonomic characters useless) and biogeography, with special reference to the New Zealand species.

Biosystematics of the *Kunzea ericoides* (A.Rich.) Joy. Thomps. complex

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Is *Kunzea ericoides* (A.Rich.) Joy.Thomps. divisible? That's a question that has haunted New Zealand and Australian botanists for at least the last 23 years since Thompson transferred the species from *Leptospermum* J.R.Forst. et G.Forst. to *Kunzea* Rchb. In fact, for New Zealand this question goes right back to William Colenso, who recognised a number of distinct entities in what was then regarded as the one variable species *Leptospermum ericoides* A.Rich. during his 1840's wanderings. While none of Colenso's manuscript names were accepted by Joseph Hooker, he was not alone in seeing distinct entities in this variable species. Thomas Kirk named several in 1899 and later in the 1945 George Simpson added another. It transpires that Harry Carse, Donald Petrie, and Vic Zotov among many others also saw distinct entities and their herbarium specimens show this. So is *Kunzea ericoides* correctly placed in *Kunzea*, is it indigenous as Thompson believes or endemic to New Zealand, is it one species, two, three, or even more, and is it really one of the world's 100 worst weeds? Over the last seven years research into these questions using a variety of standard morphological and ecological techniques, supplemented by cytogenetic investigations and the use of molecular markers suggest that these early pioneering botanists may well have been right in their views – *Kunzea ericoides* is an aggregate species. This paper reviews progress toward a full Australasian revision of the *Kunzea ericoides* complex.

Pollination and reproductive biology

Keynote speaker

Pollination systems in New Zealand

Linda Newstrom-Lloyd
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Richard Toft, Margaret Stanley, Alastair Robertson, Adrian Monks, Merilyn Merrett, Lara Nicholson, Joanna Rees, Neil Fitzgerald, Bruce Thomas, Taina Witt, Richard FitzJohn, Jacqueline Beggs, Bill Lee

New Zealand has a mixture of exotic and native pollinators visiting both exotic and native plants with either niche overlap or clear differentiation depending on the plant species. Specialisation from a plant's perspective is defined as pollination by a "small" subset of all available pollinators. Based on data from 8 sites, we found strong floral visitor preferences with various degrees of specialisation at several levels depending on the context of a plant population or individual. Three patterns emerged from the data: (1) Native and exotic plants that are characteristically shared by native and exotic visitors depending on the site. For native species in areas lacking their native pollinators (birds or bees), the substitution of exotic pollinators could have significant conservation value. (2) Exotic plants that are not regularly visited by natives. For plant species with closed access blossoms, this pattern can give rise to an "invasive mutualism" which has implications for introducing exotic pollinators to off-shore islands. (3) Native plants that are not favoured by exotics for some reason. In addition, some native and exotic plants show clear patterns of bee or fly dominated visitation that represents the potential for *cryptic specialisation.* To develop a predictive understanding of pollination systems in New Zealand, we require investigation of these floral preferences in terms of the mechanisms underlying them such as visual and olfactory cues that attract or deter visitors and restrictions based on accessibility, quantity and quality of nectar and pollen. Further study of the dynamics of hierarchies of floral visitor preferences will clarify the effects of plant and pollinator composition on the resilience of community level pollination systems.

Combined vs separate sexes in the land plant clade

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Linley Jesson
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The conditions of separated or combined sexual functions are reassessed across the whole land plant clade, with an emphasis on whole life cycles, the diversity of gender morphs found in populations, and on individuals' relative contributions to the next generation via sperms vs eggs. We propose a new classification that divides land plants into four functional classes. In dimorphic sporophytes and gametophytes, morphs that reproduce mostly as males and females may be constant (dioecy) or inconstant (gynodioecy, androdioecy). These conditions may be distinguished as haploid or diploid depending upon the life cycle stage they occur in. Within cosexual sporophytes and gametophytes, the unisexual sporangia or gametangia respectively may be presented together (synoecy) or separated spatially (herkogamy, including monoecy and variants). Their maturation may be synchronous or separated temporally (dichogamy, including protandry & protogyny). The terminology used in bryology does not adequately distinguish gender from herkogamy and requires modifications.

Hermaphrodites, sex distribution, and sex determination in *Dactylanthus taylorii*

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Helen Jonas, Barbara Ambrose

Dactylanthus taylorii (Balanophoraceae) is a holoparasitic flowering plant endemic to New Zealand. Its long-lived underground tuber is attached to the root of a host tree or shrub, with inflorescences of tiny, strongly reduced flowers often the only visible sign of the plant above ground. *D. taylorii* is generally regarded as dioecious and populations in the wild are usually strongly dominated by tubers producing male inflorescences. Surprisingly, young tubers in sowing trials have predominantly produced female inflorescences in their first years of flowering. Furthermore, hermaphroditic inflorescences, until now thought to be aberrations only, are found to be more common in wild populations than previously thought. Initial findings do not confirm that hermaphroditic inflorescences represent a regular transition from male to female state of a single individual. Instead, they may be an indication of stressed or senescent *D. taylorii* plants. The morphology of hermaphroditic inflorescences and the transitional stages between male and female flowers will be presented. The proportion of male and female flowers varies between hermaphroditic inflorescences and even between spadices within a single inflorescence, though their general arrangement is constant with female always found below male flowers. Contrary to previous interpretations, the male flower consists of two anthers rather than one.

Widespread failure of bird-pollination mutualisms on the New Zealand mainland

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Dave Kelly, Alastair W. Robertson, Jenny J. Ladley

Cheeseman published some of the first observations on bird pollination in the native flora in 1882 and 1890. Here we review current knowledge of the status of this mutualism in the face of declines in the native avifauna. There are about 30 native plant species with flowers visited by birds, and the extent of pollen limitation has been studied in 13 of them, usually for more than one year or at more than one site. Two species (15%) routinely automously self-pollinate, three species (23%) were never significantly pollen-limited, while eight species (62%) were significantly pollen limited at some or all mainland sites. Overall, 43% of all species/site/year combinations on the mainland showed significant pollen limitation. The few comparable studies on islands with high bird densities have not found pollen limitation to be occurring there. These data suggest widespread faltering of bird-pollination mutualisms on the mainland. Studies on two related aspects (inbreeding depression and seed limitation) suggest that the reductions in seed set caused by reduced pollinator service will have negative demographic consequences for the plant species.

Science, conservation, and conservation management

Keynote speaker

From Pattern to Process: Ecological and genetic approaches to the analysis of plant population viability

Andrew Young
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Effective management for long-term maintenance of plant biodiversity requires both an understanding of the distribution and abundance of species (pattern), and a good knowledge of the genetic and demographic processes that determine the fitness of individuals, the viability of populations and, ultimately, the local persistence of species (process). Much conservation biology effort has gone into determining plant distribution patterns over the last 100 years and how these relate to climate and environment and, more recently, how these change in relation to land management. With ongoing climate change understanding these relationships is a conservation research imperative. In contrast however, there is much less information about the demographic and genetic processes that actually underpin these patterns and environmental relationships. Partly this is because quantifying the spatial and temporal dynamics of plant population dynamics to assess intrinsic rates of increase to predict the probability of extinction or growth is an extraordinarily difficult task. This is particularly true in fragmented or degraded habitats where the scales and frequencies of critical processes such as pollination, seed dispersal, recruitment and flowering may have changed significantly in response to disturbance. Nevertheless, knowledge of these basic population processes, their relative influence on population viability, and how they are affected by landscape condition and structure is critical if we are to be successful in conserving the planets plant communities. Of particular interest is using this knowledge to improve our ability to successfully integrate conservation of plant biodiversity and maintenance of ecological function within mixed natural-agricultural landscapes. A sound scientific footing for doing this is now essential as such landscapes represent the only arenas for the conservation of many diverse plant communities. Here I will outline several studies that have used ecological, genetic and modelling methods to investigate the importance of factors such as mate limitation, inbreeding and hybridisation in determining the viability of native plant populations in Australian agricultural environments and how these data have been used to develop management strategies aimed at minimising extinction risk.

From Science to Community - The Conservation of *Atriplex hollowayi*

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This talk will illustrate how taxonomic work resulted in an intensive conservation management programme for the Nationally Critical endemic strand plant *Atriplex hollowayi*. It will outline how the local community has been encouraged to participate in conservation efforts and talk about successes in terms of community involvement and the conservation of *A. hollowayi*.

Plant conservation in the South Islands high country – challenges and opportunities

David A. Norton
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The eastern South Island high country comprises a substantial number of plants that have been ranked as either 'Threatened' or 'At Risk' by the New Zealand Threatened Plant Committee. However, the nature of rarity in the high country is complex and must be viewed within the context of the human-induced nature of many high country ecosystems. While some plants are genuinely threatened with extinction, others that are declining may simply be contracting back to their pre-human disturbance distribution. Others are naturally uncommon and not threatened with extinction at all. In fact some of the most threatened plants in the high country are species that would have historically been abundant and are still abundant elsewhere in New Zealand. Not only is the nature of rarity in the high country complex, but so too are the management responses required to address species decline. In particular simplistic management responses such as removal of domestic grazing animals alone while addressing decline in some species may in fact increase the threat for other species.

Hope for mistletoe

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Fiona Anderson

Cheeseman's flora noted that scarlet mistletoe *Peraxilla colensoi* was 'a very handsome species' that was found in some specified North Island localities and was 'not uncommon in wooded districts throughout' the South Island. Today South Westland is one of the last strongholds for scarlet mistletoe. Densities of around 30 individuals per hectare in mixed beech-podocarp-hardwood forests have been recorded. Two other species of beech mistletoe (*P. tetrapetala* and *Alepis flavida*) and the green mistletoe (*Ileostylus micranthus*) are also present. The fact that South Westland was one of the last parts of mainland New Zealand to be invaded by the Australian brushtail possum (*Trichosurus vulpecula*) is the most likely reason for the relative abundance of mistletoe, particularly scarlet mistletoe.

Evidence to support this conclusion comes from:
1. Mistletoe species comprising an average of 32% of the spring diet of possums diet in the mixed beech-podocarp-hardwood forests of South Westland;
2. A strong negative linear relationship between foliage cover of scarlet mistletoe and possum trap-catch;
3. A strong positive exponential relationship between mortality of scarlet mistletoe and possum trap-catch.

Extensive possum control largely using aerial application of 1080 is currently underway over about 180,000 hectares in South Westland. Evidence to date from managed sites suggests that the trigger for possum control should be set at 5-8% trap-catch. The Hope Valley, which was the last part of South Westland to be invaded by possums, provides a baseline against which the success of mistletoe management can be measured.

From flora systematics to conservation, a rocky road – case studies from the moss world

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During systematic studies for the ‘Flora of New Zealand, Mosses’ the threatened status of several taxa has become apparent. Attempts to use the new knowledge to protect mosses out in the real world have had varying success. Examples from the families Fissidentaceae and Pottiaceae will be discussed.

Back to the future: the incredible functional and aesthetic superiority of NZ's native dune plants

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Just as beach sand accumulates in the lee of near-shore islands and reefs, it can also be accumulated by dune plants. But not all sand-dwelling plants are created equal, with native dune plants again, for the first time in over 100 years, demonstrating their clear superiority in all regards. Earlier and vast human degradation of New Zealand's highly adapted suite of native sand-trapping and sand-binding dune plants had largely destroyed their natural and impressive accretionary function, with calamitous results.

During this period the degraded dune area involved was *"about 40,000ha in 1880; by 1909 the estimate had risen to over 120,000ha"* amounting to a catastrophic 95% of the estimated total dunelands (129,000ha[3]) in 1911 New Zealand.

Over the last century, the instability problems and vacuum created by earlier destruction of native dune species has been largely and inadequately filled by a plethora of imported and less functional species, like Marram, Lupin, Lyme Grass, Kikuyu, Ice Plant, Gazania, Arctotis, Indian Doab etc.

Re-introduction of the functionally and aesthetically superior native front-dune species has been possible only over the last decade, as propagation techniques have become understood and refined.

In a 1976 letter to the Bay of Plenty Catchment Commission a leading botanist stated *"I would pin little hope on being able to propagate pingao for use as a sand binder…marram is much more useful….and planting presents few difficulties"*.

A breakthrough in dune restoration objectives occurred in 1995 when Jo Bonner of Whakatane pioneered the commercial production of spinifex to add to the pingao already in production. These two key native dune species were now available in quantities for serious dune restoration work to begin. The positive results and implications for future coastal management techniques are dramatic.

The differences in dune function and aesthetic appeal of native versus introduced plants are very pronounced and unequivocally in favour of the perfectly adapted indigenous species.

The positive results and repercussions for future coastal management techniques in New Zealand are dramatic, positive and obvious. The critical need for a nation-wide dune restoration programme utilising only the functionally superior native dune species is discussed.

Conservation and hybridisation in the Waimakariri Basin

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The Castle Hill buttercup (*Ranunculus crithmifolius* subsp. *paucifolius*) is a rare plant found only in a small area of limestone gravel at Castle Hill. Known as Kura Tawhiti to Maori, the area is located in the Waimakariri basin northwest of Christchurch.

A phylogenetic study of chloroplast and nuclear DNA sequences by Lockhart and coauthors divided the New Zealand alpine *Ranunculus* species into 4 groups, and suggested that the Castle Hill buttercup may have had a hybrid origin. To test this hypothesis we undertook an expanded sequencing study, and initiated a DNA fingerprinting study of *R. crithmifolius* subsp. *paucifolius* and its closest relatives using AFLP.

70 samples from 20 taxa of New Zealand alpine *Ranunculus* were sequenced for both cpJ_{SA} and nITS data. While sequencing of additional samples from group III did not confirm a hybrid origin for *R. crithmifolius* subsp. *paucifolius*, considerable sequence variation was found within the breeding group (Fisher, 1965). Patterns of variation were consistent with chloroplast capture occuring between three of *R. crithmifolius* subsp. *paucifolius* close relatives, *R. crithmifolius* subsp. *crithmifolius, R. enysii*, and *R. insignis*.

Micromorphological floral characters suggested a relationship between *R. insignis* and *R. enysii*, so *R. insignis* was chosen to investigate hybridisation as an explanation of the chloroplast capture phenomenon. 27 characters from 47 accessions of *R. insignis* were analysed using morphometric data and multivariate statistics. The morphometric data suggests that the *R. insignis* complex should be split into three taxonomic groups as they were pre-1965.

Further chloroplast capture investigation will involve morphometric and SEM data from more accessions and species, along with parallel development of microsatellite DNA fingerprinting markers suitable for New Zealand alpine *Ranunculus*.

Plant morphology, cytology, and function

Keynote speaker

Why chromosomes still count

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Work on the chromosomes of New Zealand plants over the past 60 years has been remarkably successful and chromosomes numbers are now available for approximately 80% of the vascular flora. In contrast very little is known about the chromosomes of the non-vascular flora, the mosses and liverworts, and clearly the focus should now turn to these groups. Chromosome studies have shown that the majority of species are neopolyploids and many are characterised by having large numbers of small chromosomes. However, chromosome studies on the vascular flora are not now nearing completion as there is more to the study of chromosomes than simply counting how many are present in a given individual or species. The development of molecular techniques has resulted in a variety of insights into how chromosome data can be used and how chromosomes evolve. Examples from both the endemic and exotic flora will be used to showcase some of these new developments.

Extremophilic algae: a selection from New Zealand, Antarctica, and North America

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Freshwater algae may colonise extreme habitats that cannot be exploited by most forms of life. Extremophiles are present in many lineages, and include terrestrial cyanobacteria in the Antarctic Dry Valleys, chlamydomonad snow algae in temperate mountain areas, and acidophilic streptophytes in streams contaminated by mining activities. Interesting aspects of the evolution, ecology, and physiology of these disparate organisms will be presented, together with illustration of their habitats and diversity.

Matai and miro (*Prumnopitys*) – the inside story on the rumour of their separation

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Prumnopitys taxifolia (matai) is characterised by its spicately arranged pollen cones and ovulate cones. In contrast, *P. ferruginea* (miro) has solitary pollen cones and ovulate cones. Such morphological differences have cast doubt on the current delimitations of the genus *Prumnopitys*. The reproductive structures and life cycles of matai and miro were investigated to find out whether there are any differences of taxonomic significance at the generic level.

Embryologically these two species were found to be very similar to each other and to the Chilean *Prumnopitys andina* (the type of the genus), the only other *Prumnopitys* species whose embryogeny is known. The life cycles of these three species share several primitive features (such as 7-8 prothallial nuclei in the mature pollen grain; 2-4 long tapered archegonia in the ovule; a 3-tiered proembryo resulting from 5 free-nuclear divisions before cell formation) that point to their basal position in the Podocarpaceae and hence in conifer embryology generally.

Despite their embryological similarities, new morphological and anatomical differences between matai and miro have emerged from this study. For instance, in matai pollen cones, the microsporangia are free, whereas in miro they are fused; in matai ovules, a tanniniferous layer develops in the epimatium, whereas in miro ovules a tanniniferous layer develops in the integument. Such differences, when added to the characters which already distinguish these two species, may be sufficient to warrant their separation into two genera.

Melikian and Bobrov, in 2000, have already proposed, among other things, that *Prumnopitys* be split into 3 genera, and erected the Prumnopityaceae (sic). However, until the other 6 species currently in *Prumnopitys s.l.* are better understood, it seems prudent to retain the current classification, especially since the new generic name proposed for miro (*Stachypitys*) has been deemed illegitimate.

Chromosome relationships of the New Zealand and Australian Orchidaceae; independent evidence for the recent generic recircumscriptions

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The Orchidaceae is one of the largest families of flowering plants, with more than 800 genera and c. 25 000 species distributed worldwide.

The Australasian component is an important part of the world orchid flora — its isolation from the Northern Hemisphere has resulted in independent evolution and great diversity among the indigenous taxa. In Australia, there are currently 1304 named taxa in 193 genera. New Zealand has a smaller, but nevertheless significant representation with more than 120 species in 36 genera. As currently circumscribed, about half the species are shared with Australia and there are six New Zealand endemic genera.

There have been relatively recent and extensive taxonomic recircumscriptions of the Australasian taxa, but some of these generic and subtribal “splittings” are controversial and not universally accepted. Some orchidologists prefer a more conservative treatment, and argue that Australasian genera have often been recircumscribed in a brief manner, referring to but without yet fully publishing the underpinning morphological and molecular studies. They also contend that much of the molecular evidence presented relies upon few gene regions.

Chromosome morphology and number provide important characters independent of macromorphological and molecular data. Ernst Beuzenberg and Murray Dawson, in collaboration with a long-term taxonomic study of the New Zealand Orchidaceae by Brian Molloy, have produced chromosome counts for all 36 genera and about 75% of the described species of the New Zealand indigenous orchids, as well as a representative sample of Australian taxa.

Extensive cytological diversity was uncovered, with examples of aneuploidy, polyploidy, and amphidiploidy. In many cases, the chromosome evidence have proven remarkably informative, and strongly supports recognition of segregate genera and their recent subtribal and phylogenetic placements. This paper provides an overview of our findings.

Plant phylogeny and biogeography

Keynote speaker

Phylogenetics, Taxonomy, and Biogeography

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A phylogeny is the evolutionary relationships amongst a group of organisms. Because it happened only once, evolutionary history provides an objective basis from which to build a taxonomic classification. Recognising only monophyletic groups (in which all members are more closely related to each other than to any individual outside the group) as formal taxa adds to the objectivity of a classification. However, our knowledge of most organisms' phylogeny is incomplete, and taxonomic changes often need to be made as more is learnt. Furthermore, there is no agreed means of ranking groups within the Linnean hierarchy. Topical examples demonstrating these taxonomic issues are *Hebe*/*Veronica*, *Doodia*/*Blechnum*, and *Trichomanes*/*Hymenophyllum*. Phylogenies are also necessary for understanding evolutionary patterns, including aspects of biogeography. Recent work has demonstrated that much of the New Zealand flora is geologically 'recent', but we still know very little about patterns of genetic diversity within New Zealand.

Origin and biogeography of New Zealand *Craspedia* (Compositae: Gnaphalieae) based on ITS, ETS and *psb*A-*trn*H sequence data

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The present study, by inferring a phylogeny from a representative sample of *Craspedia* using DNA sequences, tested the hypothesis that New Zealand *Craspedia* is monophyletic, resulting from one colonisation event from an Australian progenitor.

Craspedia is restricted to New Zealand and Australia. In New Zealand it is a geographic outlier in the subtribe Angianthinae, the remaining c. 60 genera are endemic to Australia. The majority of *Craspedia* are concentrated in temperate climates of south east Australia and New Zealand, an unusual distribution, as species in the Angianthinae are for the most part found in semi-arid habitats of inland Australia.

Analyses of ITS and ETS intergenic spacers recovered three main lineages. The first lineage consists solely of the Australian species *Craspedia haplorrhiza,* the relationships of which are unresolved, and the second includes species that are also exclusively Australian in distribution. The third lineage comprises two monophyletic groups; one including all the remaining Australian species sampled and the other, all New Zealand entities sampled. Monophyly of New Zealand *Craspedia* is also supported by analysis of *psb*A-*trn*H intergenic spacer sequences. Australian alpine species are independently derived from within the two larger Australian lineages. *Craspedia* in Tasmania is polyphyletic, with both of these lineages represented, and with most Tasmanian species being closely related to Australian mainland species. The single lineage of New Zealand *Craspedia* and the low divergences between Australia and New Zealand *Craspedia* samples are consistent with the derivation of New Zealand *Craspedia* via a single dispersal event from south-east Australia in the Late Tertiary or Quaternary. Compared with Australian *Craspedia*, the New Zealand species show extensive morphological divergence but little sequence divergence, suggesting a recent and rapid species radiation.

Phylogenetics and Ecology in the Study of Alpine Plant Evolution and Distribution: A Case Study of New Zealand Alpine *Ranunculus*

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The New Zealand alpine *Ranunculus* are a morphological and ecologically diverse group thought to have undergone a rapid radiation following the Pliocene orogeny. The focus of this study is the range expansion of *R. insignis* and *R. verticillatus* from the South Island to the North Island, and the subsequent hypothesised formation of the allopolyploid *R. nivicola* from these species. Within the North Island these species currently have distinctly different distributions, of particular note is that there is no known location where all three species co-exist.

To date few studies have attempted to model individual plant distributions in the alpine zone. However, the recent development of Landcare's Land Environments New Zealand (LENZ) database has the potential to facilitate this type of study in New Zealand alpine environments.

Here I present an investigation into the potential of LENZ for helping to understand current species distributions of the alpine *Ranunculus*. Inferences gathered from this geospatial analysis are discussed within the context of phylogenetic history.

Phylogeography of *Ourisia* (Plantaginaceae): An integrated study of a New Zealand alpine radiation

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In high-elevation areas of New Zealand, multiple genera have undergone radiations resulting in ecologically and morphologically distinct yet genetically similar species. A question of much interest is the extent to which geological history, ecological factors, and genetic factors have shaped patterns of alpine plant evolution and speciation in New Zealand. To reconstruct the evolutionary history of the *Ourisia* radiation, we generated data from DNA sequencing markers as well as amplified fragment length polymorphism (AFLP), a multi-locus genomic fingerprinting technique. We sampled individuals from multiple populations throughout the geographic range of each of the 12 New Zealand species of *Ourisia* plus the Tasmanian outgroup, generating AFLP profiles using four different primer-pair combinations for 275 accessions. We analyzed the data using a variety of methods, including reconstruction of phylogenetic trees and networks. To assess the relative utility of AFLP to resolve evolutionary relationships in the New Zealand alpine flora, we compared our results to trees reconstructed from nuclear (GBSSI) and chloroplast (*trn*C-D intergenic spacer) DNA sequence data for a subset of the accessions. In general, AFLP and GBSSI analyses are largely congruent with taxonomy, whereas the cpDNA dataset shows some geographic structuring. To investigate potential ecological factors that may be driving the New Zealand *Ourisia* species radiation, we used a Geographic Information Systems (GIS) platform that allowed integration of microhabitat data from the Land Environments of New Zealand (LENZ) with genetic data and phylogenetic history.

New Zealand Plant Phylogeography: The riddle of the "Beech Gaps"

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The present day distribution of *Nothofagus* in New Zealand shows characteristic gaps that do not have obvious ecological explanation. Different explanations for these gaps have been proposed. Some authors have proposed that the Westland Beech Gap between Haast and Hokitika is the result of fault-meditated displacement of terranes starting in the Miocene. Other authors have argued that this gap is the result of localised extinction due to Pleistocene glaciation and a subsequent failure of taxa to reinvade. We have sequenced six different chloroplast markers (2.5 kb) in 75 accessions of *Nothofagus* (*N. menziesii* and fuscospora species) from across New Zealand. Phylogenetic relationships and inter-population divergence times have been estimated, and the biogeographic history of species has also been studied using nested clade analysis. The strikingly different evolutionary histories of *N. menziesii* and fuscospora beeches are discussed.

The Biological Complexity of New Zealand *Epilobium* L. (Onagraceae)

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In 1976, Raven and Raven revised Cheeseman's treatment of the genus *Epilobium* in New Zealand. Based on morphological analyses, they suggested that the New Zealand species had undergone a rapid, extensive radiation in the vast range of unexploited habitats present in New Zealand during the Plio-Pleistocene, resulting in 37 species of *Epilobium* comprising five primary species groups. Raven & Raven proposed a series of hypothetical relationships between these 37 species based on morphological and ecological affinities. They also suggested that high levels of interspecific hybridisation during the evolution of the group, followed by continued hybridisation among several modern species, would result in potentially reticulate relationships among members of the group and species relationships which may not be easily discerned. To test these hypotheses, DNA sequences from the nuclear ITS repeat region and the chloroplast *trn*L-F marker were obtained from over 120 *Epilobium* accessions collected from the South Island of New Zealand.

The sequences were analysed using Bayesian inference and the resulting gene trees compared using consensus network analysis. Significant levels of incongruence were observed between the gene trees, suggesting that processes associated with lineage sorting or hybridisation may have been acting upon this group. Further analyses were carried out in order to unravel the potential causes of this incongruence. The findings from these analyses will be discussed.

Polyploid evolution of New Zealand *Asplenium*: new insights from chloroplast and nuclear DNA markers

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Polyploidy has been an important factor in generating diversity in the New Zealand members of the fern genus *Asplenium*. Most New Zealand *Asplenium* species belong to a closely related 'Austral' group whose lowest ploidy level is tetraploid. Eight tetraploid and nine octoploid taxa are recognised within the Austral group. We investigated the origins of the octoploid taxa by sequencing nuclear *leafy* and chloroplast *rbc*L and *trn*L-*trn*F DNA sequences. Phylogenetic analyses support the recognition of three morphological subgroups within the Austral group. Nuclear DNA sequences indicate that allopolyploids have formed between each of the three subgroups, with *A. hookerianum* playing a major role in the formation of many octoploid taxa. The majority of octoploid taxa demonstrate no or few sequence differences from their parental species implying that they have formed relatively recently and may not persist over geologically long time periods. Chloroplast sequences indicate that some octoploids have formed independently multiple times and this may have important consequences for the conservation of rare taxa e.g. *A. cimmeriorum*.

A land of recent immigrants: stories from plant DNA sequences

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DNA sequence information is making an increasingly important contribution to plant taxonomy. Once a well documented database of DNA sequences has been established, plant identification can in theory become highly automatable. In addition, even small fragments of plant material can be readily identified. As well as its role in taxonomy, DNA sequence information can be used to deduce the biogeographical history of organisms. We report here the results of an initial project aimed at establishing DNA barcode information for a subset of the New Zealand flora. The nucleotide sequences of the ITS region of nrDNA has been determined for several hundred taxa of New Zealand native plants. This initial project focused particularly on several monocotyledon taxa. A recurring theme of the data for many genera is the existence of multiple immigration events into New Zealand. Some of these immigration events appear to be quite recent, and in some cases, the immigration event has been followed by a burst of speciation.