TE TAIAO

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Manaaki Whenua
Landcare Research

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BioBlitz – finding nature in the city

Recently, two 24-hour BioBlitz events were held in a quest to record the biodiversity of central city parks. In Auckland more than 60 biologists scoured Auckland Domain, and in Christchurch, Manning Intermediate pupils joined about 80 scientists to brave adverse elements in the Botanic Gardens and Hagley Park, to search for as many non-human life forms as possible – from plant viruses, bacteria and algae, fungi, and plants, to fish and mammals.

BioBlitz has several goals. One is to demonstrate to the public that biodiversity encompasses much more than the readily visible plants and large animals. Another is to document what actually is there – the indigenous species, and both desirable and undesirable exotics. In 24 hours, we cannot hope to find everything, but such large teams of specialist biologists can produce impressive lists that are important baseline information for ongoing monitoring and management.

A third goal is to give scientists from many different organisations an informal, relaxed opportunity to work together with common purpose on a fun (albeit serious) project. It allows researchers to make new contacts and strengthen networks, and to convey more effectively their science to the public.

In total, 1575 species were recorded in Auckland and nearly 1200 in Christchurch, in addition to the nearly 6000 planted species associated with the Botanic Gardens.

In Auckland native suprises included four species of wētā, a giant centipede, adult banded kōkopu (whitebait), and a new species of fungus. In Christchurch, interesting finds included a native kōura (freshwater crayfish), a remarkably tiny myrmid 'fairy fly', little owls, a new record for New Zealand of an *Oedogonium* alga, and several types of edible mushrooms.

Birgit E. Rhode

Stephen Moore discussing freshwater invertebrates with a young visitor to the Auckland BioBlitz.

Judy Grindell

Phil Novis and University of Canterbury's Paul Broady identifying freshwater algae at the Christchurch BioBlitz.

***Thanks to*:** **Auckland**: Royal Society of New Zealand, Auckland Museum, University of Auckland, DOC, Auckland Regional Council, and Auckland City Council helped Manaaki Whenua organise the event and took part. Crop & Food Research, Unitec and Auckland Botanical Society also participated. **Christchurch**: Lincoln University, Christchurch City Council and Christchurch Botanic Gardens helped Manaaki Whenua organise the event. Crop & Food Research, NIWA, Manning Intermediate, University of Canterbury, Canterbury Museum, ECan, DOC, and NZ Ornithological Society also took part.

Ko te taiao te oranga o te tangata
Ko te tangata te oranga o te taiao

The Environment sustains mankind
Yet it is man who sustains the environment

Of slugs and snails and…biodiversity tales

New Zealand's island setting, wide climatic variation, dynamic geological history, and heterogenous landscape has produced complex natural patterns of biodiversity. The biota is extraordinarily distinctive, typified by relict lineages of plants and animal groups of Gondwanan origin, high levels of endemism, spectacular speciation within some plant and animal groups, and the notable absence of many plant (e.g. herbaceous annuals) and animal (e.g. herbivorous and carnivorous mammals, snakes) groups or life forms that have major roles in ecosystems in continental areas. Analyses of plant and vertebrate diversity have led to recognition of the New Zealand region as one of 25 global biodiversity hotspots. This hotspot status is undoubtedly applicable to the biota as a whole, but there is little information on more than 95% of the species – annelids, arthropods, nematodes, molluscs, fungi, microbes – that constitute New Zealand's endemic terrestrial biodiversity. Currently, decisions about conservation management and resource use are largely made without recourse to information on these small critters. Further, there is little understanding of the role of invertebrates, and the consequences of the unique make-up of New Zealand invertebrate communities, in the functioning of our ecosystems.

Michael Schneider, Ad Venture Media

Phenacohelix giveni with shell diameter of 6 mm, on a dead leaf skeleton. The majority of New Zealand landsnails are detritivores, living in the litter and feeding on the micro-organisms associated with decay.

Rod Morris

Thalassohelix ziczag – shell diameter 5–7 mm.

Rod Morris

Paryphanta busyi – shell diameter 80 mm. Members of the Rhytididae are predators, feeding on earthworms, other snails and, in some cases, amphipods. Many of these carnivores are giants relative to the more numerous detritivorous snails.

The New Zealand landsnail fauna is globally distinctive, and illustrates many of the evolutionary and community patterns seen in the New Zealand invertebrate fauna as a whole. Of the 80 or more landsnail families known globally, only 11 families are represented here – a low representation at the family level simply reflects the largely sub-global distributions of families. Nonetheless, a peculiar feature of the New Zealand landsnail fauna is the absence of families that tend to dominate landsnail faunas elsewhere.

At the generic and species levels, though, the New Zealand landsnail fauna is hyperdiverse. Spectacular evolutionary diversification has occurred in families with recognised Gondwanan affinities. The result is a fauna of about 1400 species – the most speciose in the world for the land area – and all but five of these species are endemic to New Zealand. Much of this diversity has yet to be formally described. For example, collections at the Museum of New Zealand Te Papa Tongarewa and at Auckland Institute and Museum presently house at least 450 species-level taxa of the family Charopidae from New Zealand, but only 210 of these species have been formally described. Similarly, 90 punctid species have been described and currently recognised as valid, distinct entities within the New Zealand region, but collections presently house at least 286 additional undescribed New Zealand species-level taxa.

Another internationally idiosyncratic feature is that taxonomic diversification of landsnails has occurred with little apparent ecological diversification. Elsewhere, variation in shell shape tends to exhibit a bimodal distribution, with species possessing either a tall shell or a subglobular to flat shell. Often, different phylogenetic clades have divergent shell morphologies when they coexist in a region, and display greater variation in shell form when they occur alone. Shell shape is evidently evolutionarily tied to niche characteristics – where and how species seek out a living – and begs the question of how families come together and share out the ecological opportunities. Despite the apparent absence of competitors , the New Zealand landsnail fauna is strongly dominated by small species with flat shells.

New Zealand landsnails are also remarkable for the extraordinarily high numbers of species that can occur at individual sites. For example, in northern North Island forests, communities of 30–70 snail species can occur within a few square metres. This number of

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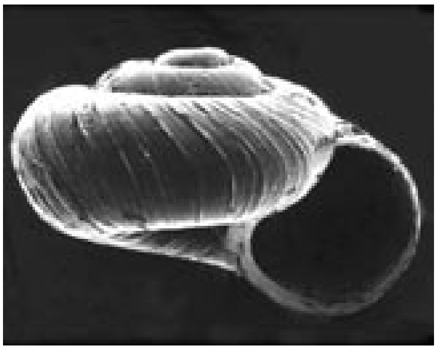
Michael Schneider, Ad Venture Media

Tornatellides subperforata – shell 3–4 mm high. Snails with a tall-spired shell are relatively rare in New Zealand. This species is common on coastal forests and shrublands from the Kermadec Islands to northern areas of the North Island, living both in the litter and on vegetation.



Gary Barker

Paralaoma servilis – shell diameter of 1.5 mm. While the shell size in New Zealand snails ranges from 0.85 to 113 mm, the majority of species possess a shell of between 1 and 10 mm in size.

Gary Barker

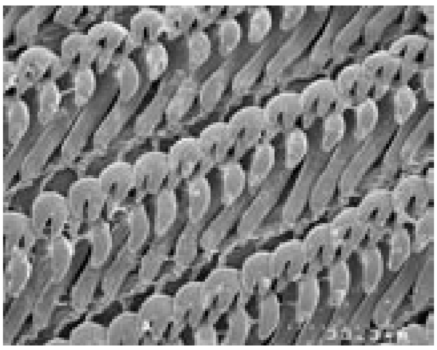
An undescribed species of Athoracophoridae from southern Westland. Snails evolving in very wet habitats often 'sacrifice' the protection offered by possession of a shell for the mobility, fast body movements and ability to occupy very small spaces afforded by the reduction or elimination of the shell.

species in communities – often referred to as alpha or sympatric diversity – contrasts markedly with the 5–10 species typical of landsnail communities elsewhere in the world. Only in some temperate forests of Europe and North America, and tropical rainforests of Africa and Madagascar, is this level of diversity approached, with 20–45 species occasionally recorded. Other areas in New Zealand may support modest landsnail diversity.

Recognition of the remarkable community diversity in New Zealand has motivated a suite of studies in forest systems in various parts of the world, all addressing one primary question: 'what are the special conditions that allow high alpha diversity at some sites but not at others?'

In recent years Gary Barker and collaborators have established a dataset of community composition at 2485 plots across the New Zealand region. Further, working collaboratively with Te Papa, a comprehensive database of species distributional records has been established for the New Zealand landsnail fauna. For invertebrates, these datasets are globally unique in their degree of taxonomic and geographic coverage and for their quantitative description of community composition. These datasets offer unique opportunities to address questions of relevance to biodiversity management in New Zealand and internationally. Presently we are using these data in two research areas. First, we are addressing the linkage between macro-scale evolutionary and ecological processes and how communities are formed. Second, we are working with the Department of Conservation to determine conservation priorities by analysis of patterns of diversity and levels of biodiversity protection in the New Zealand landscape.

Funding for research on landsnails is provided by the Foundation for Research, Science and Technology. Funding from the New Zealand Biodiversity Strategy TFBIS project is enabling wider access to landsnail information, and funds from the Department of Conservation are enabling analyses of conservation priorities.



Gary Barker

The feeding organ of landsnails is the radula – a tongue-like structure covered by a thin chitinous membrane bearing minute teeth arranged in rows. The teeth are worn down by abrasion, and new rows continually added.

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Fergusoninidae: an unusual family of fly new to New Zealand

The discovery in spring 2003, by Nicholas Martin and a friend, of a gall-forming fly living in the base of leafy shoots and inflorescences of some pōhutukawa (*Metrosideros excelsa*) trees along the beach of Karekare, Auckland, caused a stir amongst dipterists. The 4 mm adult was distinctive and strikingly coloured: yellow and dark brown body, purple eyes, and dark smoky wings. An Australian specialist, Gary Taylor of the University of Adelaide, quickly confirmed that it was a species of Fergusoninidae, a family not previously recorded in New Zealand. Most species of this family live in Australia, with a few species also known from India and southeast Asia. In Australia, larvae of this family live in leaf, bud, and stem galls on myrtaceous plants (particularly *Eucalyptus*) in a remarkable association with nematodes.

So, was this Auckland discovery an Australian species that had somehow made its way to New Zealand and found pōhutukawa a suitable myrtaceous host? It was soon apparent that this was a new species of *Fergusonina*, endemic to New Zealand. A biosecurity breach, with associated host switching from *Eucalyptus*, had not occurred. Our new species had distinctive features, including an adult larger than any described species, and a reduced larval dorsal shield unlike any known species.

Flies of *Fergusonina* and nematodes of the genus *Fergusobia* form the only recorded mutualistic association between insects and nematodes: together they induce galls in young meristematic tissues in Myrtaceae. In October 2004 nematologist Kerrie Davies of the University of Adelaide came to Auckland to confirm if a distinctive *Fergusobia* nematode species was associated with the New Zealand species of *Fergusonina*. She found the nematode in the galls, and confirmed that it also was a new species endemic to New Zealand. This confirmation now meant the remarkable fly–nematode association existed in New Zealand. *Metrosideros*, the plant genus that includes pōhutukawa and rātā, was a new plant host for Fergusoninidae.

The complex fly and nematode association has yet to be studied in the New Zealand species, but it is not likely to differ greatly from that between Australian species. Galls appear to be initiated by the feeding of juvenile nematodes injected into plant tissue during oviposition by the female fly. These nematodes develop into parthenogenetic females. Fly eggs hatch and the larvae form individual cavities within the gall into which the nematodes migrate and cohabit with the fly larva. Some of the gelatinous cell-sap oozes from the cells on which the nematodes have been feeding and becomes available to the first and second instars of the fly. The nematodes pass through at least one parthenogenetic generation and lay eggs that develop into (possibly haploid) males and diploid females. This sexual generation copulates, and fertilised, female, preparasitic nematodes invade the fly larva late in the third (final) instar. By the pupal stage of the fly development the nematode moults without developing a new cuticle, the stylet is lost, the oesophagus and digestive tract degenerate, and the epidermis develops microvilli through which the nematode apparently absorbs nutrients from the fly haemolymph. Hundreds of eggs are produced and deposited in the fly haemolymph. After hatching, juvenile nematodes move to the ovaries of the developing adult fly. It is not known whether nematodes invade male fly larvae, but they do not occur in adult male flies. Following emergence of the adult female fly from the gall and its dispersal, fly eggs and juvenile nematodes are again both deposited into new plant material during oviposition. The nature of this association can be described as mutualistic, as the flies appear to depend on the nematodes for gall initiation, and the nematodes on the fly for dispersal. *Fergusobia* nematodes are the only known example where the life cycle includes plant parasitic generations, both parthenogenetic and sexual, followed by an insect parasitic generation.

Birgit E. Rhode

The adult fly has dark wings and looks like a hoverfly when resting. The body is mainly bright yellow with dark setae.

Birgit E. Rhode

Mature fly larva (ventral view). The blunt end is the head. The dark spot between third and fourth visible segments from the head (the dorsal shield) is characteristic of the genus and diagnostic for the species.

Birgit E. Rhode

Pupa of fly, with eye spots of the adult visible.

Birgit E. Rhode

Gall at the base of a vegetative shoot of pōhutukawa (*Metrosideros excelsa*). Note that the stem is thicker and has shorter internodes than the adjacent shoot. Also be aware that shoots that look like this can result from other causes. To see if it is a *Fergusonina* gall, the gall needs to be opened.

Why then has no-one noticed or collected this gall-forming species previously, especially as it is associated with one of New Zealand's iconic tree species? We can only put forward suggestions at this stage. The gall is inconspicuous, with only the shortened internodes and slight swelling of the base being evident. As the shoot is usually not killed, there are no conspicuous patches of dead material that might attract attention. Probably entomologists have not collected the striking adults because they have not collected or put out suitable traps around pōhutukawa in coastal areas during the late spring and summer period.

The presence of *Fergusonina* in New Zealand raises questions of how it became associated with *Metrosideros* as a host. For instance, was it originally associated with *Eucalyptus*, then switched host before *Eucalyptus* became extinct in New Zealand by the early Pleistocene? Or did it switch to *Metrosideros* early on during the Tertiary period when *Eucalyptus* was common in New Zealand? And if so, were there fergusoninid species dependent on *Eucalyptus*, which became extinct with their usual host species? Whatever questions are pursued, however, it is certain we have a lot to learn about this remarkable fly and its nematode, and they may provide further clues on the origin and evolutionary radiation of our biota.

Funds for this research were provided by the Foundation for Research, Science and Technology and Australian Biological Resources Survey.

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Hydroseeding with mosses and other early-colonising species

A team of scientists from Manaaki Whenua and HortResearch, in collaboration with Palmerston North based Rural Supply Technologies and the coal mining company Solid Energy, have recently developed methods for hydroseeding mosses and other early-colonising species for revegetation.

Practical techniques for revegetating difficult sites with local indigenous species have challenged environmental engineers and ecological restoration experts. Steep, rocky roadside banks, quarry and mine pit walls, bouldery side-slopes of mine waste-rock-dumps, and natural erosion scars have both physical and chemical constraints for revegetation. They are prone to erosion, are usually devoid of soil and plant rooting media, and the surface materials do not hold much water. They lack plant-available nutrients (particularly nitrogen and phosphorus), and may be very acidic, depending on the geological nature of the rock on the site. Climatic challenges for plant establishment and growth add to the other constraining factors, particularly in subalpine and alpine environments or areas subjected to severe frosts, intense rainfall or drought.

Craig Ross

Hydroseeding moss mixture onto a bouldery sandstone waste-rock-dump slope at Stockton Mine.

Jill Stanley, HortResearch

Ground cover of mosses, *Epilobium* sp. (a prostrate herb) and the native grass *Rytidosperma* sp. on a bouldery waste-rock-dump slope at Stockton Mine 5 months after hydroseeding.

It is often impractical to revegetate these difficult sites by traditional planting or direct transfer methods. Seeding with indigenous species of vascular plants generally does not work well because plant establishment is extremely slow and there are often problems with ground instability and weed invasion. Hydroseeding with exotic grasses and legumes, such as browntop (*Agrostis capillaris*), tall fescue (*Schedonorus phoenix*), lotus (*Lotus pedunculatus*), dogstail (*Cynosurus cristatus*), and white clover (*Trifolium repens*), generally produces rapid vegetative ground-covers that stabilise the slopes. However, dense grass–legume vegetation inhibits the emergence of native seedlings, thus hindering, rather than helping, the restoration of indigenous vegetation.

The research team looked to natural revegetation processes to find a solution to the problems of establishing indigenous plant species on these difficult, disturbed sites that are devoid of soil. Mosses, lichens, and prostrate herbs are among the earliest natural colonisers, establishing in 'nooks and crannies' where there are fine particles of soil-like materials. These species stabilise the surface rocky ground and start early soil development processes. International research and our observations have shown that mosses can improve the germination, emergence, and survival rate of juvenile vascular plants. Vascular plant succession follows these early colonisers, with seedlings of grass, flax, shrub, and tree species establishing in the micro-sites provided by the colonisers. Thus 'seeding' with combinations of locally sourced colonising mosses, lichens and herbs, and vascular native plant seeds, or oversowing with the vascular plants at a later date when the mosses, etc. have established, provides a potential technique to overcome the problems of revegetating these difficult sites.

Research trials were conducted to speed up these natural plant colonisation and successional processes, based particularly on mosses. Both dry and wet (hydroseeding) application methods were trialled. Dry application by hand or through a blower machine was reasonably successful at a research plot scale, but hydroseeding proved to be the more practical method of application. Hydroseeding uses a tank and high pressure pump to spread a mixture of water, seeds, fine mulches, plant materials, and other additives (e.g. glues, microbial innocula, and fertiliser). Hydroseeding also enables revegetating materials to be sprayed onto very steep slopes and vertical rock walls, without disturbing the site by trampling. Our work used truck- or trailer-mounted hydroseeding machinery, but aerial application by helicopter, with modified fire-fighting monsoon buckets, is feasible and has been successfully used for hydroseeding moss

Jill Stanley, HortResearch

Mosses with some grasses on a rocky, hard sandstone roadside bank at Stockton Mine, 6 months after hydroseeding.

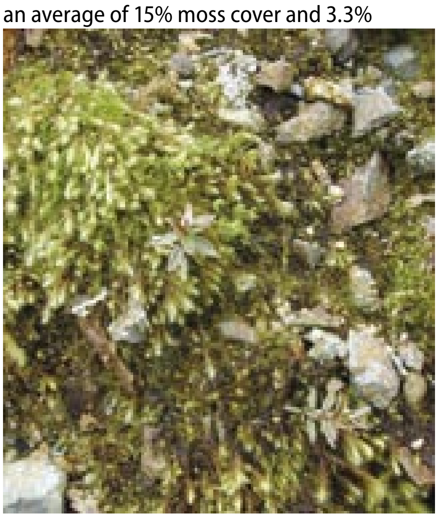
Rowan Buxton

Mosses and some grasses on a steep, bouldery granite mine pit wall at Stockton Mine, one year after hydroseeding.

mixtures at Strongman Mine – as well as for traditional grass–legume mixtures elsewhere.

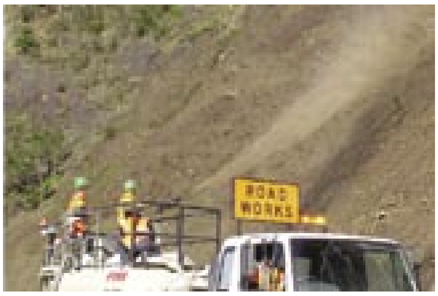
Trials in New Zealand began in 2001, following earlier studies at the Grasberg Mine in West Papua, Indonesia. Experimental trials at Stockton Coal Mine, near Westport, and commercial applications at both Stockton and Strongman (north of Greymouth) mines have successfully demonstrated moss hydroseeding on waste-rock piles and roadside banks. The plant response is better on granite rock types than hard (sometimes pyritic) sandstone, and on sheltered southern aspects than on exposed north-facing sites. Vegetation cover of up to 20–40% at a micro-site (0.25 m^2) scale can be established in these subalpine environments within 6 months.

Small-scale trial results on a granite-veneered waste-rock-dump slope at Stockton gave an average of 15% moss cover and 3.3% vascular plant cover after a year compared with 0.1% and nil respectively for control plots where nothing was applied. Vegetation covers had increased to 26% moss and 14% vascular plants compared with 1.5% and 0.5% respectively, after 2.5 years.



Jill Stanley, HortResearch

Mānuka seedlings emerging in hydroseeded moss on a bouldery sandstone waste-rock dump at Stockton Mine.



Craig Ross

Hydroseeding moss mixture onto a slip face in the Manawatu Gorge.

Larger-scale trials are now verifying the results from the initial small-plot trials. A hydroseeding trial on a sandstone waste-rock-dump slope had, after 1.5 years, an average of 12% moss cover and 7.1% cover of vascular plants compared with 0.4% and 1%, respectively, for the best non-seeded control plots. The best sub-plots had moss covers of 40–50% and vascular plant covers of 20–30%. At a micro-site level, there were total vegetation covers of 60–80% compared with <2% for untreated ground. These micro-sites are important for plant extension and further colonisation of the unvegetated components on the remainder of the slopes. More-recent large-scale trials have produced mixed results, indicating that the technique requires different treatments, depending on the rock type, aspect, and specific nature of each site. Further development of the technique is required to tailor the treatments to specific sites.

At the West Coast mines we harvested the moss, lichens and colonising herbs from areas about to be excavated for mining operations. We have also collected 'seeding' plant materials by partially harvesting from significant colonies of mosses. Moss regrowth on these sites can be significantly enhanced by fertilising and covering with a cloche. Experimental moss nurseries have shown it is possible to grow 'seeding stock' quite quickly under protective cloches, with the potential for several harvests each year.

Our collaborators are now at the stage of scaling-up the experimental trials to commercial moss nursery operations, to produce the large volumes of moss materials needed for large revegetation projects.

The colonising revegetation work at the West Coast mines was extended to hydroseeding one of the large storm-induced slips in the Manawatu Gorge in August 2004. A moss mixture that also included seeds of karamū (*Coprosma robusta*), mānuka (*Leptospermum scoparium*), māhoe (*Melicytus ramiflorus*) and five-finger (*Pseudopanax arboreus*) was sprayed onto the slip face. Currently a masterate student at Massey University is working with us, trying to adapt the moss hydroseeding methods to establish ferns, particularly for developing fern-covered roadside embankments.

Funds and support for this research are provided by Solid Energy New Zealand, Rural Supply Technologies, and a Technology New Zealand TIF Education grant.

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Can we predict mast-seeding events in native forests?

Mast seeding can have profound consequences for populations of native animals, both directly because seed is a food source, and indirectly, because of the introduced mammal species that also feed on the seed. These irregular, heavy-seeding years trigger a cascade of population increases among introduced mammal species; first rat and mouse populations erupt after feeding on the seeds, followed by populations of larger mammals, such as stoats, which feed on the rats and mice. Once the seeds have been consumed, rodent populations begin to decline and the larger mammals rapidly shift their attentions to native animal species – with devastating consequences. Threatened bird species such as mohua (*Mohoua ochrocephala*) and kākāriki (*Cyanoramphus* spp.) are particularly vulnerable to predation following heavy-seeding years. If mast-seeding events could be predicted well before they occur, then intensive predator control measures could be applied at the most effective time to protect vulnerable native animal species from peaks of mammalian predation. With this aim, we are examining patterns of seed production in beech forest.

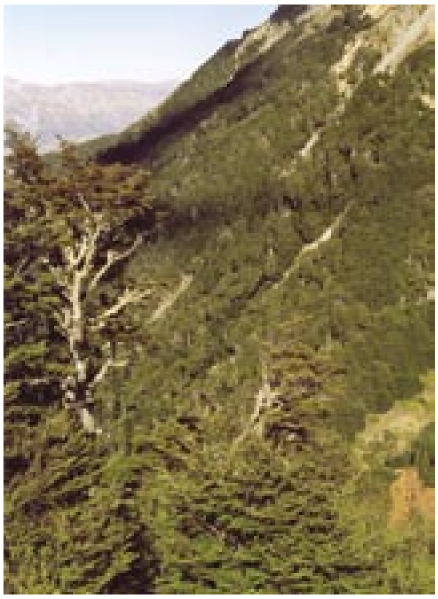
The simplest explanation of mast seeding is that trees only produce flowers and seeds in years when there are sufficient resources. There is a strong correlation between seed production and summer temperatures the previous year, and summer temperatures are known to influence important plant resources such as photosynthate (the sugars produced by photosynthesis) and soil nitrogen. Thus, because climate is highly variable among years, so too is seed production. However, a more complex explanation is that warm temperatures are not just a resource but are also a cue that all beech trees respond to. Responding to such a cue would allow individual beech trees to synchronise their flowering across a forest. This would have significant benefits as pollination would be much more likely to be successful, and because synchronised, heavy seed production would be likely to overwhelm the appetites of local seed predators ensuring that at least some seeds remain uneaten. Recent work with tussock grasses, for example, has demonstrated the need for warm temperatures both for resources and as a cue to synchronise flowering and seed production.

Kevin H. Platt

Mountain beech flower.

An understanding is needed of how seed production varies among years, among forests, and among trees within the same forest, in order to predict seed production throughout the country. At Craigieburn Forest Park, Canterbury, seed production in mountain beech forest, *Nothofagus solandri* var. *cliffortioides*, has been measured every year for the last 40 years (the longest-running quantitative study of seed production anywhere in the world). In 1965, circular seed traps were positioned along transect lines at various elevations, from 1000 m to 1340 m (alpine treeline) on Mt Wall, to examine how seed production is affected by temperature, which decreases with elevation. Craigieburn Forest has also been the location for a range of other ecological studies, so there is now a wealth of information on mountain beech ecology, soil chemistry, and climate available to help interpret seed production patterns.

Seed production at each of the studied elevations has been highly variable among years. Much of this variation can be correlated with the temperature of the previous summer (when the tissues that produce flowers are formed) but a small part can also be attributed to cool, moist summers occurring in the previous two years (when photosynthesis would not be restricted by drought or high temperatures, and so photosynthate could accumulate). Summer temperatures have increased since the study began, and we expected this would affect seed production.



Sarah Richardson

Craigieburn Forest Park, Canterbury, where seed production by mountain beech forest along an elevation gradient has been measured for 40 years.

Matt Durham

Melissa Brignall-Theyer collecting seeds from traps at Craigieburn. Seeds are collected and counted every 6 weeks between March and September.

Accordingly, we examined the seeding data for long-term trends, looking at two aspects: the mean number of seeds per year, and the frequency of low-, medium- and heavy-seeding years. Mean seed production had increased over the 40-year period, particularly at high elevations, which suggests that cool temperatures at high elevations limit seed production – and could imply that global warming will enable high-elevation forests to produce more seeds in the future. Also, in the second half of the study period, there was an increased frequency of medium-seeding years. Rising summer temperatures correlated directly with the increase in mean seed production and the increased frequency of medium-seeding years.

Obviously, to produce more seeds, trees will need more resources. We therefore examined how warmer temperatures could result in greater resource availability to trees. Using

Janet Wilmshurst

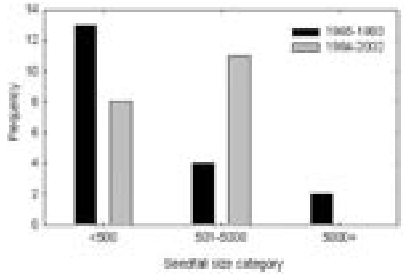
Mountain beech seeds are 5–7 mm long and weigh <0.5 mg to >10 mg.

information from other studies at Craigieburn on climate, soil structure, and mountain beech growth, a model was constructed to estimate the amount of photosynthate produced each year by the forest. Surprisingly, although summer temperatures increased over the 40-year period, this did not strongly affect the amount of photosynthate produced by the trees. Changes had occurred in atmospheric CO2, temperature, and precipitation that, overall, were unfavourable to photosynthesis, so the net effect was a negligible trend in photosynthate.

If photosynthate is not the resource enabling beech to seed more frequently, then what other resource could be driving the relationship between warmer temperatures and more seeds? With colleagues Murray Davis and Peter Clinton from FRI we set up an experiment adding fertiliser nitrogen to mountain beech forest to examine how availability of this important plant nutrient affects tree growth and seed production. The experiment has only been running for a few years, but already it is clear that mean seed production can be increased by adding fertiliser. In warm years, the warm soil promotes soil processes, such as nutrient availability, so we propose that, with rising summer temperatures, soil fertility is increasing and that this is providing mountain beech trees with the resources to seed more frequently.

Seed production at Craigieburn can now be predicted with a reasonable degree of certainty, but this understanding must be extended to locations where fauna conservation is a priority. Increases in mean seed production and shifts towards at least medium-seeding events every year are both likely to have massive implications for native birds that are vulnerable to introduced mammals.

The work was financially supported by the former New Zealand Forest Service, the former Ministry of Forestry, and the Foundation for Research, Science and Technology. SR was funded from Landcare Research's retained earnings.



Frequency distribution of annual seedfall events for the first and second halves of a 38-year period. The period 1965–2002 was divided in half, and for each half the frequency distribution of annual seedfall events was calculated. A comparison of these two frequency distributions indicates that low-seed events (<500 seeds) were more common in the first half, while medium-sized seedfall events (501–5000 seeds) were more common in the second half. Data are from seed traps at 1340 m, Craigieburn Forest Park.

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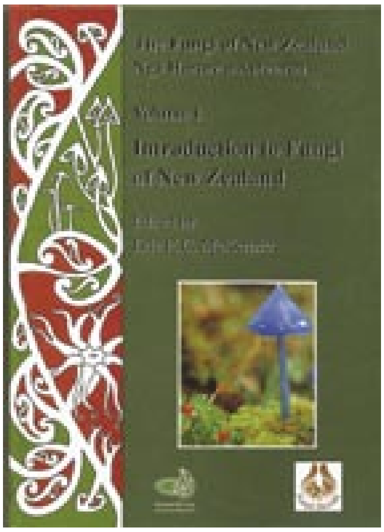
Fungi of New Zealand / Ngā Harore o Aotearoa



Front cover, Volume 1, *Introduction to Fungi of New Zealand.*

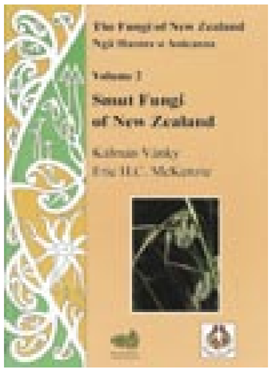
On 23 February 2005, the Hon. Chris Carter, Minister of Conservation, together with his British counterpart, the Hon. Ben Bradshaw, UK Minister for Nature Conservation & Fisheries, officially launched a new Landcare Research publication series – *Fungi of New Zealand* / Ngā Harore o Aotearoa – following the publication in 2004 of Volume 1, *Introduction to Fungi of New Zealand*. This hardcover volume (of c. 500 pages, and weighing in at a sturdy 1.7 kg) forms a solid foundation upon which the previously published 'orphans', Volume 2, *Smut Fungi of New Zealand* (2002) and Volume 3, *Myxomycetes of New Zealand* (2003), can now stand, eventually to be joined by Volumes 4 and 5 (in preparation) and other yet to be initiated volumes in an open-ended series.

Fungi of New Zealand sits alongside the two companion series that Manaaki Whenua inherited from DSIR: *Flora of New Zealand* (beginning in 1961) and *Fauna of New Zealand* (beginning in 1982). The relatively late start of a series dealing with New Zealand mycology perhaps reflects the traditional treatment of fungi as merely a subset of the Plant Kingdom – indeed the new series' earliest forebears were a chapter by the Rev. M.J. Berkeley, in J.D. Hooker's *Flora Novae-Zelandiae* (1855), and subsequently a chapter in Hooker's *Handbook of the New Zealand Flora* (1867). Modern molecular phylogeny confirms the 'true' fungi as a Kingdom in their own right; moreover, one with closer affinities with the Animal Kingdom than with the Plant! (Nevertheless, the vestiges of the old allegiances still linger on, e.g. in the retention of the forthcoming second edition of D.J. Galloway's *Flora of New Zealand Lichens* (1985) as a volume in the Flora series, rather than in the Fungi series.)

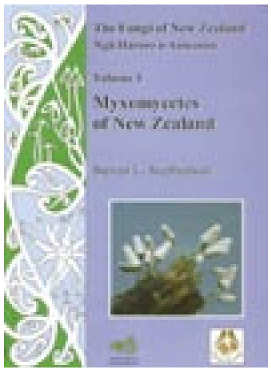
Another facet of the recentness of the recognition of fungi as a separate kingdom is the absence of any established term, analogous to 'Flora' and 'Fauna', to describe a mycological publication series. Rather than try to concoct a neologism – 'Fungora'?; 'Mycora'? – we have opted for the safe, conservative, and obvious. It has the virtue of avoiding ambiguity. Or has it? The series will spread its umbrella over all the groups that have traditionally been treated as fungi, and studied by mycologists. However, modern molecular phylogeny again complicates the picture; while the 'true' fungi are placed in Kingdom Fungi, some primitive 'fungal' groups are now placed in Kingdom Chromista (with primitive 'plants', e.g. algae) and others in Kingdom Protozoa (with primitive 'animals').

The choice of a Māori title for the series presented a somewhat different linguistic challenge – what is the Māori word that best represents 'fungi' in the general sense? The evidence and arguments are marshalled in Volume 1, in a chapter on Māori Knowledge of Fungi / Mātauranga o Ngā Harore. After extensive discussion with the Māori Language Commission, it was agreed that 'harore' was the apposite word. You may remark the different font in which the Māori title of the series is printed. Our intention is to acknowledge the legacy of the earliest Māori language printing presses, which historically employed this style of font.

A unifying theme across the different volume covers is the panel of Māori art designed by Liz Grant, Palmerston North. The basic inspiration



Front cover, Volume 2, *Smut Fungi of New Zealand.*

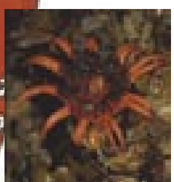


Front cover, Volume 3, *Myxomycetes of New Zealand.*

is the kōwhaiwhai pattern (of interweaving koru), into which Liz has incorporated instantly recognisable stylisations of two of New Zealand's iconic fungi: werewere kōkako or *Entoloma hochstetteri*; and puapuatai or *Aseroe rubra*. A different form of Māori art is represented in the Frontispiece of Volume 1, 'Harore', painted by esteemed sculptor, carver, artist, and educator, Arnold Manaaki Wilson.

What of the contents of Volume 1? The preliminary matter includes a bilingual Preface to the series, a bilingual Abstract of the volume, and 16 pages of annotated coloured plates illustrating the diversity of 'some of the more conspicuous, colourful, and distinctive species found in New Zealand'; and the main text is assembled into seven chapters. Chapter 1, The Fungi of New Zealand — An Introduction, collates the contributions of a multiplicity of authors, introducing the New Zealand status of the particular taxonomic or ecological groups of fungi in which they specialise. Two complementary

G.L. Barron



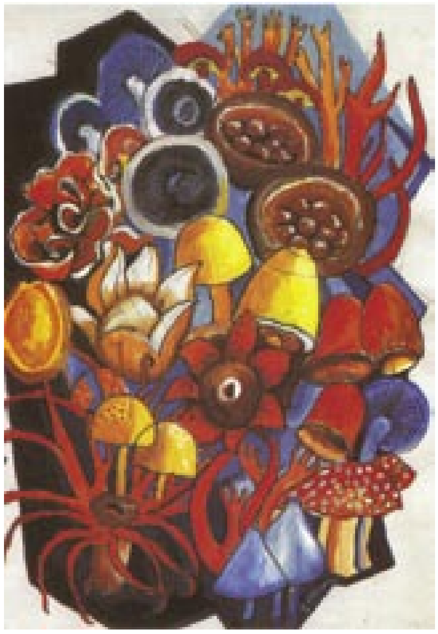
R.E. Beever

Front cover kōwhaiwhai panel (left) designed by Liz Grant, incorporating stylisations of *Entoloma hochstetteri* (upper right) and *Aseroe rubra* (lower right).

historical and cultural perspectives on the fungi of New Zealand are provided in Chapters 2 and 3: The History of Taxonomic Mycology in New Zealand; and Māori Knowledge of Fungi / Mātauranga o Ngā Harore (the latter based on a Masters thesis by Rebekah Fuller). Next are two chapters that focus on the most conspicuous group of fungi, the agarics and boletes (gilled and pored mushrooms); they provide a taxonomic key to all the genera known to occur in New Zealand, and an extensive bibliographic checklist covering the nomenclature and literature pertaining to all the agaric and bolete names that have been applied to New Zealand material, both historically and currently. Chapter 6 is a Bibliography of New Zealand Taxonomic Mycology, drawing together in a single alphabetical listing all the publications in which new fungi have been described from New Zealand material, together with significant New Zealand monographs, historical floristic lists, and ecological and phytopathological compendia. The final chapter, Checklist of New Zealand 'Fungi', is unique in two respects: it is the first comprehensive listing of all the fungi reported from New Zealand (across Kingdoms Fungi, Chromista, and Protozoa, as indicated by the quotation marks in the chapter title); and it is the first New Zealand listing in which lichenised and non-lichenised fungi have been integrated into a single sequence, breaking down the old compartmentalisation that resulted in species within the same genus being segregated on the presence or absence of a photosynthetic symbiont.

All volumes of *Fungi of New Zealand* / Ngā Harore o Aotearoa are published by Fungal Diversity Press, Hong Kong (as volumes within their Fungal Diversity Research Series), and are available for purchase through Manaaki Whenua Press.

Funding for fungal research in New Zealand is provided by the Foundation for Research, Science and Technology.



Volume 1 Frontispiece, 'Harore' by Arnold Manaaki Wilson.

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http://nzfungi.LandcareResearch.co.nz [New Zealand Fungi website]

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Mosses of New Zealand

A new work in the *Flora of New Zealand* series, *Flora of New Zealand Mosses*, is currently in preparation. A Flora is a synthesis of the current knowledge and so naturally builds on earlier works. This new work has rich antecedents. 150 years ago, in 1854, J.D. Hooker and the English bryologist W. Wilson published the first moss Flora. Subsequently, between 1914 and 1929, H.N. Dixon (one of the foremost bryologists of his time) published a series of taxonomic commentaries on New Zealand mosses. The capable amateur bryologist and Gisborne lawyer, G.O.K. Sainsbury, published *Handbook of New Zealand Mosses* in 1955, and it remains the standard treatment of New Zealand mosses. Sainsbury corresponded with Dixon, and often relied on Dixon's taxonomic judgements, and he had access to the collections of two remarkable students of New Zealand mosses, K.W. Allison and W. Martin. Excellent handbooks of the more conspicuous mosses were produced by Allison and Child in 1971 and Beever, Allison and Child in 1992.

Our understanding of mosses has grown in the 50 years since Sainsbury's Handbook. During the 1970s and early 1980s, the indefatigable collector John Bartlett added significantly to our known flora. In 1983, Bryony MacMillan and Allan Fife, then of DSIR, organised a bryological field meeting at Pelorus Bridge Reserve, Marlborough. Succesive meetings have become the increasingly popular John Child Bryophyte Workshops held throughout New Zealand – the 20th was held in Golden Bay last year. The workshops have led to increased interest in mosses and, in turn, the discovery of many new taxa and extensions of known species ranges.

In recent years, molecular studies have transformed moss systematics. Concepts of relationships within the Class Bryopsida (true mosses) have changed dramatically and classification schemes have entered a period of flux, yielding classifications that are dramatically different to the classifications that were accepted through much of the 20th century.

A new moss Flora for New Zealand, co-authored by Allan Fife and Jessica Beever and fully illustrated with drawings by Rebecca Wagstaff, is approaching completion. Some 521 species will be treated, distributed among 207 genera and 60 families. The Flora will enable identification of the 521 species using dichotomous keys, generic and species descriptions, and diagnostic line drawings. For each species there will be a summary of its habitats, its regional and world distributions, and notes detailing the most diagnostic features of each taxon and providing clear comparisons with similar-appearing taxa.

Each species will be assigned to phytogeographic elements based on their worldwide distributions. The five dominant elements in the New Zealand moss flora are endemic, adventive, bipolar, austral, and Australasian.

The endemic fraction of the moss flora is lower than for flowering plants, with 115 species (c. 23%) of the indigenous moss species considered endemic. Some of these endemic species are extremely restricted geographically. *Epipterygium opararense*, for example, is documented only from c. 175 individuals on a single boulder – a total distribution cover of less than 2 m^2. This is also the only Southern Hemisphere locality for the genus *Epipterygium*; its closest relatives occur in tropical America.

Even though few adventive mosses are documented in New Zealand, they may pose a threat to indigenous species. *Rhytidiadelphus squarrosus*, for example, was first documented in New Zealand in 1975 and in 30 years has become widespread on roadsides and roughly mown areas in the South Island; it appears unable to invade intact native vegetation. In 1997, however, the Northern Hemipshere 'shaggy moss' (*R. triquetrus*) was discovered in scrub adjacent to Nelson Lakes National Park. This species, given its ecology as a dominant terrestrial species in much of the boreal Northern Hemisphere forest, deserves special monitoring or even eradication at Nelson Lakes. Fortunately, only non-reproductive male plants

Allan Fife

A showy, endemic, and unnamed South Island species in the genus *Pleurophascum*. This fruiting colony grew on Denniston Plateau. The affinities of this Australasian genus of three narrowly endemic species remain poorly understood.

Allan Fife

Ptychomnion densifolium, a predominantly South American species in the Ptychomniaceae, is known in New Zealand from scattered high elevation shrubland localities on the South, Stewart, Auckland, and Campbell islands.

Nigel Mahoney

Epipterygium opararense, with stems c. 10–15 mm tall, is an endemic species with an exceedingly narrow range from the Oparara Valley, Kahurangi National Park.

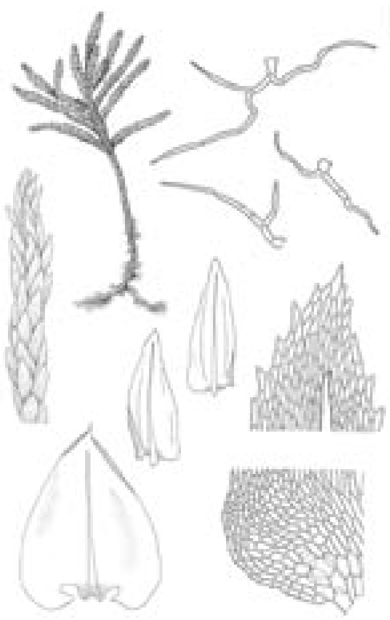
of this dioecious plant are established here. Another probable introduction, *Sphagnum subnitens*, is currently expanding its range on the West Coast. Known to 'moss' (*Sphagnum cristatum*) harvesters as 'weasel moss', its presence decreases the value of bales of moss that are exported in the multi-million-dollar trade with Asia. Its abundance increases after harvesting of *S. cristatum*.

The determination of species as adventive is often subjective, and species that have been regarded as 'bipolar' may instead represent 19th century introductions. For example, *Climacium dendroides* and *Aulacomnium palustre*, conspicuous species of South Island montane and subalpine wetlands, have been considered indigenous to New Zealand, but features of their life cycles (neither produce capsules in New Zealand), distributions, and collection history (they were not collected by astute 19th century collectors) suggest they may have been early European introductions.

About 100 indigenous mosses exhibit austral distributions (20% of the flora), usually with disjunct populations or sibling species in temperate South America. The origin of such disjunctions, whether from rafting of ancient vegetation assemblages on continental land masses or from recent dispersal events, is debated. Recent evidence from molecular studies on flowering plants suggests dispersal events as the more plausible explanation, although molecular support for this explanation in mosses is lacking. One austral moss, *Entosthodon laxus*, occurs on the geologically young Kerguelen and Macquarie islands as well as in New Zealand and South America.

Our flora also contains many predominantly austral groups, including the distinctive family Ptychomniacae and the unrelated genus *Blindia*. The Ptychomniaceae, including the conspicuous ground-dwelling and epiphytic species in New Zealand forests, are generically most diverse in New Zealand, but most species-rich in South America. The aquatic

Cladomnion ericoides, a New Zealand endemic species and genus in the family Ptychomniaceae, is a common epiphyte in wetter parts of most of New Zealand. Line drawing by Rebecca Wagstaff for the moss Flora of New Zealand.



Climacium dendroides, long considered a 'bipolar' species in the South Island, may be an early introduction from the Northern Hemisphere. Line drawing by Rebecca Wagstaff for the moss Flora of New Zealand.

genus *Blindia* has seven species here, and narrow endemics scattered throughout its predominantly Southern Hemisphere range.

The current moss Flora project is scheduled for completion in 2007. It will provide a current statement about mosses in New Zealand. Many systematic, ecological, historical, and phytogeographic questions will remain for future research after this date. Historical biogeographic methods, for example, in which a group phylogeny is postulated and then correlated with geological events, could be applied to austral groups such as Ptychomniaceae and *Blindia* to contribute to our understanding of Southern Hemisphere biogeography. The detailed descriptions and illustrations prepared for the Flora will also provide a firm foundation for production of more popular or web-based publications such as illustrated interactive keys or distribution maps based on Allan Herbarium specimen information.

Funds for the moss Flora are provided by the Foundation for Research, Science and Technology.

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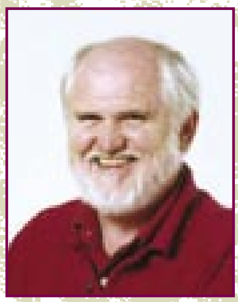

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Te wāhi ki ngā ngata i roto i te matahuhuatanga koiora (Of slugs and snails and…biodiversity tales pp 2–3)

Kua puta te kōrero ko Aotearoa tētahi o ngā tino āhuru mōwai e 25 o te ao mō te kaha matahuhua o ōna koiora. Engari he itiiti nei ngā pārongo mō te nuinga o ngā iti a Tāne kāore e kitea i ētahi atu whenua o te ao. Ko tētahi rōpū he tino tūāporoporo ngā kōrero mōna, ko ngā ngata noho whenua – arā ko ngā ngata me ngā hātaretare, he iti ake i te 2.5 mm te rahi o te nuinga, e noho nui ana ki te papa o te ngahere, i waenga i ngā hanga popo. Tekau mā tahi anake ngā whānau ngata noho whenua i Aotearoa, engari kei te āhua 1400 ngā momo (ko tētahi 95% kei Aotearoa anake), ā, he maha tonu kāore anō i whakaahuatia.

Ko tētahi mea whakamīharo o ngā ngata noho whenua, ko te tini o ngā momo tērā ka noho tahi. I ngā ngahere o Te Tai Tokerau, tērā ētahi hapori ngata e 30 ki te 70 ngā momo ngata o roto, e noho tahi ana ki ētahi mita pūrua ruarua noa iho. E 5-10 noa iho pea ngā momo e noho tahi ana ki ngā hapori ngata i ērā atu tōpito o te ao.

Kua whakatūria tētahi huinga raraunga mō te āhua o ngā hapori i ētahi āpure 2485 puta noa i te motu, ā, kua takoto mai he putunga raraunga mātotoru tonu o ngā mauranga mō te tohanga o ngā momo. Mā ēnei huinga raraunga ahurei (mō ngā hanga tuarā-kore) e taea ai te whewhera ētahi pātai e hāngai ana ki te whakataki i te matahuhuatanga koiora.

Fergusoninidae: he whānau ngaro rerekē kua hou mai ki Aotearoa (Fergusoninidae: an unusual family of fly new to New Zealand pp 4–5)

Nō te kōanga 2003 i kitea ai he ngaro hou, korokē anō hoki i Aotearoa, i tētahi pukuwhenewhene i ētahi pōhutukawa e tipu ana i te takutai i Karekare, i Tāmaki-makau-rau. Ahakoa nō tētahi whānau kāore i kitea i Aotearoa i mua atu i tēnei, ehara te ngaro nei i te rāwaho i urutomo i ngā tūwatawata haumaru koiora – he momo hou nō konei taketake ake, nō te puninga *Fergusonina*.

Ko ngā ngaro anake o tēnei puninga ngā pepeke e mōhiotia ana he hononga taupurupuru ō rātou ki te noke rango. Waihoki, i kitea iho he noho tahi tēnei ngaro hou nei ki tētahi noke rango, he momo hou anō te noke nei, ka mutu nō Aotearoa anake, pērā anō i te ngaro.

Ahakoa kāore anō i rangahaua te hononga i waenga i ngā hanga e rua nei, i Ahitereiria he tūātinitini te hononga i waenga i ngā ngaro me ngā noke rango. Kia whakatō te ngaro pakeke i ana hua ki roto i ngā kiko o tētahi tipu, ka whakatōkia atu anō hoki he punua noke rango. Nā ēnei noke ka tīmata te tipu o te pukuwhenewhene. Ka whānau mai ngā hua o te ngaro, ka mahi mai i ōna anō kōhao i roto i te pukuwhenewhene. Noho tahi ai ngā noke rango me ngā ngaro. Ko te painga ki ngā torongū ngaro, kua āhei rātou ki te pia e puta ake ana i ngā pūtau tipu e kaikainga ana e ngā noke rango. Kātahi ka whakaputa uri ngā noke rango, ā, ka urutomo ngā punua o te reanga hou i ngā torongū ngaro. I reira ka tipu hei noke māmā, me te ngote i ngā wai o roto tonu i ngā ngaro hei oranga mō rātou. Ka tuku hua ngā noke māmā nei, ā, ka kuhu atu ngā punua o te reanga hou nei i ngā wharekano o te ngaro. Ina puta ake te ngaro i te pukuwhenewhene tawhito, me te kimi wāhi hei tuku i āna hua, kua takatū rātou kia 'wahaina' ki te wāhi hou ki reira hangaia ai te pukuwhenewhene hou.

Te whakamahi wairehu hei whakatō kākano pūkohu me ētahi atu tipu tōmua (Hydroseeding with mosses and other early-colonising species pp 6–7)

Mai rā anō, he mahi nui te whakakākahu anō i ngā whenua hahore ki te rākau māori. Engari nā ngā rangahautanga o nā tata nei, kua kitea he tikanga āhua whaihua tonu: ko te tuku wairehu pūkohu hei whakatō kākano.

E tipu māori anō ai he otaota i ngā wāhi uaua kāore he oneone i reira, me tīmata mai i ngā pūkohu, ngā hawahawa, me ngā otaota toro papa ka piri ki ngā konanga kei reira ētahi matūriki he āhua rite ki te oneone. I whakahaeretia he rangahau hei whakatere ake i ngā tikanga 'mate atu he tētē, whakaete mai he tētē' o te ao otaota. I taua rangahau ka kitea he tikanga hei tuku wairehu ki ngā wāhi poupou, he ranunga wai, pūkohu, kākano, matū otaota me ētahi atu mea (tae atu ki te kāpia). I tēnei mahi ka kaha noa ake te tipu o te otaota ki ngā wāhi poupou i ngā tau tuatahi e rua.

Kua whakahaeretia ētahi whakamātautau i te hukenga waro i Stockton, rohe o Westport, me te hukenga Strongman, i te raki o Māwhera. I whakamātauria anō te tikanga nei i tētahi horo nui i te Kūitianga o Manawatū, i muri i tētahi waipuke kino, i Here-turi-kōkā 2004.

Ka taea anō te matapae ngā tau e ranea ai te kākano i te wao nui a Tāne? (Can we predict mast-seeding events in native forests? pp 8–9)

Arā ētahi tau e tino nui ai te tipu o te kākano i ētahi rākau o te wao. Me te aha, he nui ngā pānga o ēnei tau ranea ki ētahi o ngā manu māori me ngā aitanga a Punga. Ko te painga i te tīmatanga, kua hākari tonu atu ngā rauropi māori, tae atu ki ngā kiore. Engari arā anō ngā hoariri rāwaho rahi ake, pērā i ngā toriura, ka nui ake ō rātou taupori i te kai kiore, kātahi ka tahuri rātou ki ngā hanga māori. Ehara, he parekura tonu te rite. Ko ngā manu māori kua tata te korehāhā, pērā i te mohua me te kākāriki, ka mōrearea kē atu te noho i ngā tau ranea nei.

Mēnā e taea ana te matapae ko ēhea ngā tau e ranea ai te tipu o te kākano, kua taea anō te whakatū tikanga ārai i te hoariri i ngā wā e tino whaihua ana, hei āta tiaki i ngā manu māori i ngā whakaeke a toriura mā ina eke tō rātou rahi ki tōna tino taumata.

Heoi anō, e taea ai ngā tau ranea te matapae, me mārama anō ki te pūtakenga o ēnei tau. Haere tahi ai te hanganga o ngā kākano me te pāmahana mahana tonu i te raumati o mua atu, e tohu ana ina piki te pāmahana, tērā pea ka nui ake tētahi rawa e hiahiatia ana hei hanga i ngā kākano. Tērā rānei ko te pāmahana teitei ake e akiaki ana i ngā rākau kia puāwai ngātahi, kia whaihua ake te ruinga hae, kia toe tonu he kākano ina kī ngā puku o te hunga māori kai kākano.

I tētahi mahi rangahau tautini i titiro ki te hanganga kākano a ngā tawai i te Papa Ngahere o Cragieburn, i piki ake te rahi toharite o ngā kākano i hangaia, te auau o ngā tau āhua ranea, me te pāmahana toharite. Ko tā ngā mahi whakatauira, tātari i ngā raraunga i whakaatu ai, kāore i kaha ake te ahotakakame, nō reira e whakaaro ana ōna karu pūtaiao kei te kaha ake pea te mōmona o te oneone i te pikinga ake o te pāmahana i te raumati, ā, koinei kē i rahi ake ai te hanganga kākano.

Ngā Harore o Aotearoa (*Fungi of New Zealand* / Ngā Harore o Aotearoa pp 10–11)

Nō nā tata nei i whakaterea ai e te Minita Tiaki Taiao tētahi raupapa hautaka hou a Manaaki Whenua – *Fungi of New Zealand* / Ngā Harore o Aotearoa – e whai ana tēnei i te tānga o te Putanga 1, *Introduction to Fungi of New Zealand*, i te tau 2004.

Mai rā anō, kua meahia atu ngā harore ki raro i te Mātāmuatanga Tipu, engari kua whakaaetia ināianei me Mātāmuatanga motuhake mō rātou, ka mutu, he tata ake ō rātou whanaungatanga ki te Mātamuatanga Kararehe i tō te Tipu.

I whiriwhiria ngātahitia ki Te Taura Whiri i te Reo Māori te kupu pai mō te 'fungi' mō roto i te ingoa o te hautaka hou nei. Whakatauria ana ko te harore te mea pai. Ko te momotuhi o te ingoa Māori, i whiriwhiria hei whakanui i ngā pūrere tā kōrero Māori tuatahi, i te mea koinei te momotuhi i whakamahia tuatahitia e rātou.

Ko te hoahoa o te uwhi hei tuitui i ngā putanga maha ka puta ā tōna wā. Ko te kōwhaiwhai te tūāpapa, ā, kua kuhuna atu e te ringatoi ētahi tauira ngangahu o ētahi harore ahurei e rua o Aotearoa: te werewere kōkako me te puapuatai. He mahi toi Māori atu anō kei mua o te Putanga 1, ko 'Harore' te ingoa, he mea waituhi nā Arnold Manaaki Wilson, tohunga tārai whakapakoko, whakairo, whakaahua, he kaiako anō.

Kei te *Introduction to Fungi of New Zealand* tētahi kupu whakamārama whānui mō te raupapa, tae atu ki ētahi titiro haere kōtui e rua ki ngā harore o Aotearoa – he titiro hītori tētahi, he titiro tikanga-ā-iwi tētahi – tētahi rārangi o ngā pukapuka e pā ana ki ngā whakarōpūtanga harore i Aotearoa, he rārangi tuitui (he tuatahi tēnei) i ngā harore o Aotearoa e whai hoa pūkohu wai ana me ērā e noho takakau ana.

Ngā Pūkohu o Aotearoa (Mosses of New Zealand pp 12–13)

Kua whakaritea kia oti mai he tauira hou o Ngā Tipu o Aotearoa – Ngā Pūkohu ā te tau 2007. Mā konei e taea ai te tautohu ngā momo pūkohu e 521 e mōhiotia ana. Mō ia momo, ka takoto he kupu whakaahua, he whakarāpopototanga o ana kāinga noho, tana tohanga ki Aotearoa me te ao nui tonu, ētahi kōrero e whakamārama ana i ngā tino āhuatanga e wehewehe ana i ia rōpū, me ētahi kupu whakataurite i ngā momo e rite ana te āhua ki te titiro atu.

Ka whakarōpūtia ia momo ki tētahi karangatanga e tohu ana i te āhua o tana tohanga ki te ao. Ko tōna 23% o ngā pūkohu o Aotearoa, kāore i whenua kē, ā, he tino whāiti te tohanga o ētahi. Hei tauira, kāore anō i kitea a *Epipterygium opararense* ki tua atu o tētahi toka kotahi nei i te Whārua o Oparara, i te Papa Rāhui ā-Motu o Kahurangi. Waihoki, ko ia anake te *Epipterygium* e mōhiotia ana i te Tuakoi Tonga o te ao. Ko tētahi atu 20% kei te Tuakoi Tonga, engari he whanaunga tawhiti, he whanaunga tino tata rānei ō te nuinga i Amerika ki te Tonga. Arā anō ētahi rōpū i Aotearoa e kīia ana he tuakoi-rua, i te mea kei te Tuakoi Raki me te Tuakoi Tonga, engari he mea āta hari kē pea ētahi o ēnei mai i tētahi tuakoi ki tētahi i te rautau 19. He ruarua ngā pūkohu rāwaho e mōhiotia ana, engari arā tētahi i āta tuhia tuatahitia he kōrero mōna i te tau 1975, ko *Rhytidiadephus squarrosus*, kua hora whānui ki ngā taha o ngā huarahi i Te Waipounamu. Arā anō tētahi, ko *R. triquetrus* te ingoa, i kitea tuatahitia i ngā Roto o Whakatū i te tau 1997, e whakararu ana i ētahi o ngā tipu māori, he urutomo ngahere nōna.

Ina whakaputaina, ka whakaatu Ngā Tipu o Aotearoa – Ngā Pūkohu i ngā mōhiotanga o nāianei ki ngā pūkohu, ka tautohu anō i ētahi pātai kāore anō kia whakautua, hei aronga mō ngā mahi rangahau i ngā tau kei te heke iho.

In brief

Iain McGregor, Waikato Times

Neil Fitzgerald removes captured tūī from mist net at Cambridge, October 2004.

Iain McGregor, Waikato Times

Banded tūī are fed sugar-water before release. Cambridge, October 2004.

Iain McGregor, Waikato Times

John Innes releases banded and transmittered tūī at Cambridge, October 2004. Fine transmitter aerial is visible behind bird's tail.

Urban Tūī

Tūī appear in rural and urban areas in the Waikato from about May onwards, then in October they depart again, presumably to nest. Last October 30 tūī in central Waikato urban areas were colour-banded and small radio transmitters were put on 25 others to track tūī wanderings. Most moved 7–16 km to nest in or near native forests, but several nests were in adjacent exotic trees and one near Hamilton was in exotic parkland. Most nests failed, usually because of predation by ship rats, possums or harrier hawks. This research suggests that, in order to increase tūī numbers in urban Waikato areas, efforts to control predatory ship rats and possums should be in the forests where tūī nest rather than in the urban areas where they overwinter. As tūī raise broods of 3–4 chicks each per season, they have the potential to increase rapidly.

Read more at: www.landcareresearch.co.nz/publications/newsletters/tui /tui _newsletter_mar2005.pdf

Bellbirds

In another study, radio transmitters and coloured leg bands have been attached to bellbirds on the Port Hills in Christchurch, as part of an investigation to determine their breeding season home range and seasonal movements. During the breeding season most radio-tagged birds remained within a radius of about 100 m. After the breeding season, colour-banded birds have been found more than 2 km from where they were banded. Understanding the types of habitat bellbirds are using during both the breeding and non-breeding seasons is critical for sustaining bellbird populations in urban and peri-urban areas in the long term.
Read more at: www.landcareresearch.co.nz/research/biodiversity/bellbird

Peter Reese, Te Papa

Male bellbird.

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