ANNUAL CONFERENCE 1988

The 35th Annual Conference was held at Turangi Outdoor Centre, and Turangi Senior Citizens Clubrooms from 25 to 28 August 1988. There were slightly fewer than usual registrants but a cohesive, cosy conference ensued. Most participants travelled overland arriving on Monday night. The conference was opened by Tumu Te Heu Heu of Ngati Tuwharetoa. The Symposim that followed, on the theme 'Disturbance in New Zealand Ecosystems', produced a lot of material relevant to a conference held in Turangi to mark the National Park Centennial. Each of the two sections, physical and biological, were capably introduced by our keynote speakers, Phil Tonkin and Tom Veblen.

The general conference programme was as follows:

Tuesday: Symposium
Wine and Cheese evening including a debate
Wednesday: Symposium
Summing up of Symposium
Contributed papers
Poster session
Annual Dinner
Thursday: Field trips
AGM
Friday: Presidential address
Contributed papers

Papers presented at the Symposim were:

Philip Tonkin: Abiotic disturbance in New Zealand ecosystems: a geomorphic perspective.
Neall and Lees: The impact of volcanism on ecosystems of the North Island.
Clarkson: Vegetation succession following recent (less than 450 years) volcanic disturbance in the North Island.
Burrows: The importance of snow avalanches as a disturbing influence in South Island mountain vegetation.
Thomas Veblen: Biotic disturbance and vegetation dynamics.
Shaw: Disturbance and the vegetation of Urewera National Park: an overview.
Stewart and Rose: Techniques for analysing forest disturbance history.
Steele: Disturbance and mountain beech forest in Tongariro National Park.
Jane: Can natural disturbance be distinguised from red deer impact in simple mountain beech forest?
White: A systems perspective on disturbance.
O'Connor and Swaffield: How is anthropic disturbance to be accommodated in landscape ecology and nature conservation.
Howard-Williams: Invasion of Lake Taupo by the submerged waterweed *Lagarosiphon major:* implications for the native flora.
Chapman: Heather invasion in Tongariro National Park.
West: *Clematis vitalba:* an invader of disturbed ecosystems.

The bus field trip on Thursday took people for a round trip in the vicinity of the Tongariro volcanoes., and the effects of many major natural disturbances. were seen and explained by on-hand experts. Similarly the aquatic field trip looked at local wet things and ' the 'muddy boot' field trip explored ecological patterns at leisurely pace.

Papers presented in the contributed papers 'Sessions on Wednesday and Friday were:

Dickinson: The Waikaia Ecological Region - results of PNA surveys of the Umbrella and Nokomai Ecological districts.
Burns & Shaw: Ecology of wild populations of kakabeak *(Clianthus puniceus)* at Lake Waikaremoana.
Williams, Courtney, Glenny & Hall: The diversity and conservation status of pakihi vegetation in North Westland.
Timmins & Williams: Permeability of PNAs to problem plants.
Hollinger: Effect of overstorey dieback on understorey light environment and seedling photosynthesis in mountain beech.
Clarkson, Clarkson & Patel: The structure and composition of two forests buried by the Taupo eruption.
McIntyre: Habitat use by cockroaches in kanuka-beech forest.
Clout, Gaze & Karl: Movements, diet and breeding of the New Zealand pigeon.
Craig & Mitchell: Vegetation qualities and whitehead stock size.
Atkinson: Opportunities for biological restoration in New Zealand.
Nugent & Challies: Deer diet on Stewart Island and its significance in relation to the impact of deer on New Zealand forests.
Triggs: Population genetics of the brush-tailed possum.
Clapperton, Sandlant & Moller: The distribution and abundance of *Vespula* wasps in New Zealand.
Gaze, Moller, Thomas & Tilley: Effects of feral honey bees and wasps on honeydew.
Beggs & Wilson: Feeding energetics of kaka in

South Island beech forest.
Wilson, Beggs & Karl: Movements and habitat use by kaka in South Island beech forests.
Halloy: A comparison of lifeforms of New Zealand.
Norton & Kelly: Mast seeding by the dioecious forest tree rimu in New Zealand.

The poster session, formally held in the hour after lunch on Wednesday, but available for people to peruse throughout, was a valuable addition to the conference. Much exchange of ideas and suggestions for future research occurred as a result of the posters presented. Posters were prepared by:
Hitchmough: The relevance to ecologists of a systematic revision of Gekkonidae.
Nugent & Sweetapple: The relative impact of three hunting regimes in Northeast Fiordland.
Fordham & Ogden: Some features of kaikawaka seedlings and their sites in Tongariro National Park.
Young: Effects of fragmentation on forest communities and the relevance of fragment area to reserve design.
Innes: Do 1080 aerial poisoning operations kill North Island kokaka?
Parkes: Condition of hares according to age, sex, and reproductive state.
Clarkson & Johnson: Recent Botany Division publications.
Leathwick: National Forest Survey data computerisation.
Shaw & Steward: Forest Research Institute PNA database catalogue.
Timmins & Williams: Characteristics of problem weeds in New Zealand's protected natural areas.

Abstracts of papers presented are listed below.

ABIOTIC DISTURBANCE IN NEW ZEALAND ECOSYSTEMS: A GEOMORPHOLOGICAL PERSPECTIVE.

Philip J. Tonkin

Abiotic disturbance originating from relatively short duration (geological, geomorphological, hydrological or climatic) events may have an immediate ecological impact within the affected area, and longer term consequences for land surface and ecological stability within the larger drainage basin. The episodic occurrence of abiotic disturbance is analysed using the conceptual framework of the fluvial system, considering concepts such as extrinsic and intrinsic thresholds, recurrence interval, complex response, and magnitude of event. These concepts are illustrated with examples of abiotic disturbance from micro to mega scale events within New Zealand. These include windthrow, landsliding and volcanic eruptions. The major conclusion is that abiotic disturbance as a phenomenon needs to be considered within the wider context of landform, regolith and soil evolution in order to put spatial and temporal changes into perspective. By implication, this will influence the interpretation of ecological stability and instability. Single events of abiotic disturbance, dependent on their magnitude, maintain or change the diversity of ecological sites within a landscape.

THE IMPACT OF VOLCANISM ON ECOSYSTEMS IN THE NORTH ISLAND

V.E. Neall and C.M. Lees

The principal volcanic processes that destroy or modify ecosystems are pyroclastic flows (nuees ardentes), acid rains and gases, lateral blasts and pyroclastic surges, debris avalanches and volcanic mudflows (lahars), tephras (from fme ash to coarse pumice or scoria) and lava flows. The role of these processes in ecosystem modification in the North Island is reviewed in combination with reference to available overseas examples and new palynological information from Mt Egmont. The response of ecosystems to these processes is also discussed with particular reference to recovery patterns ascertained from palynological studies in Taranaki.

A REVIEW OF VEGETATION SUCCESSION FOLLOWING RECENT (450 YEARS) VOLCANIC DISTURBANCE IN NORTH ISLAND, NEW ZEALAND

Bruce D. Clarkson

In the last 450 years at least 20,000 ha of indigenous vegetation in the North Island has been damaged or destroyed by volcanic disturbance, initiating primary

and secondary successions. These are reviewed and considered in relation to some recently proposed models of succession. Most of the variation in succession relates to the scale and intensity of disturbance, and the type and heterogeneity of the substrate emplaced. Where disturbance has been most extensive and severe, elements of slow classical successions, from lichens and mosses to flowering plants, and facilitation by nitrogen-fixers such as Coriaria, are evident. In contrast, minor disturbance results in vegetative regrowth or regeneration of surviving species. Heterogeneity of substrate enables many taxonomic groups of plants to establish more or less concurrently. Intermediate disturbance successions are not easily categorised and may contain elements of several succession models. The recently advanced resource-ratio hypothesis of succession can be used to explain the general pattern of volcanic successions outlined.

THE IMPORTANCE OF SNOW AVALANCHES AS A DISTURBING INFLUENCE IN SOUTH ISLAND MOUNTAIN VEGETATION

Colin J. Burrows

Information from Fiorland, the central Southern Alps. and the Waimakariri Basin is used to show that snow avalanches are a very common disturbing influence on mountain grassland, scrub, and forest. The local patterns of vegetation distribution in the mountains are frequently directly controlled by the positions of avalanche tracks and frequency of avalanching. In turn these depend on the positions of appropriate start zones, conditions favouring unstable snow and the topographic features of slopes.

BIOTIC DISTURBANCE AND VEGETATION DYNAMICS

Thomas T. Veblen

The growing interest among ecologists in the influence of disturbances on community organisation is a logical consequence of the inadequacies of traditional equilibrium models in ecology. The current challenge is to obtain adequate characterisation of 'disturbance regimes' as a necessary precursor to the development of truly predictive models of vegetation dynamics. Thus, efforts are currently underway to quantitatively characterise the disturbance regime of numerous landscapes in terms of disturbance area, frequency, spatial distribution, return interval, predictability, and magnititude. Methodologies for obtaining these kinds of data are discussed and examples of their application in the central Rocky Mountains and northern Patagonia are described. In the former area, the dominant disturbances are fire and lethal insect epidemics, while in the latter fire and introduced large. mammals are the main agents of disturbance.

DISTURBANCE AND THE VEGETATION OF THE UREWERA RANGES - AN OVERVIEW

W.B. Shaw

Various abiotic and biotic disturbance processes are an integral part of the environment of the Urewera Ranges. Relevant abiotic disturbances include volcanism, landslides, fire, drought, wind, snowfall, frost and hail. Biotic disturbances, or components of , disturbances, include humans, introduced animals, introduced plants, insects anti fungal pathogens.

These disturbances exert influences which reflect their areal extent, magnitude and frequency. Actual. or potential influences of the above disturbances are reviewed and their relative importance in determining the present vegetation pattern is considered.

TECHNIQUES FOR ANALYSING FOREST DISTURBANCE HISTORY

Glenn H. Stewart and Alan B. Rose

A number of non-destructive and destructive techniques are available for analysing the timing, frequency, and magnitude of natural disturbances in forest stands. Intensive age determination of trees is desirable for reconstructing forest disturbance history, but when used alone is not always sufficient to establish a disturbance chronology. Diameter and height growth patterns may provide more direct evidence of past canopy tree deaths than age.

Where large samples of ages and growth records cannot be obtained, structural attributes of forests can provide valuable supplementary evidence. Examples of the effects of disturbance history and age structure on diameter distributions are examined and principles for

interpretation proposed. Simple size distributions alone are often unreliable indicators of past disturbance and must be supplemented with other structural indicators such as crown area distributions or with age and special data.

RECONSTRUCTING DISTURBANCE ON MT RUAPEHU

Marion Steel

The effects of dieback and windthrow on the mountain beech *(Nothofagus solandri* var *cliffortioides)* forest of west Ruapehu have been assessed from the aftermath of the events. The distribution of standing dead trees indicates a pre-dieback forest dominated by large mountain beech trees. The uneven effects of dieback and windthrow have led to a more heterogeneous vegetation. Tree ring analysis supports the hypothesis that drought acted as a trigger for beech dieback.

CAN NATURAL DISTURBANCE AND RED DEER IMPACT BE DISTINGUISHED IN SIMPLE MOUNTAIN BEECH?

Graham T. Jane

Simple mountain beech forest predominates in much of Canterbury. South Island. New Zealand and some districts sustained high red deer numbers for over 40 years. although current deer numbers are low. Since 1972 over 800 permanent plots have been placed in these forests to assess animal damage and over 540 have been remeasured at least once. During this time forests have sustained severe insect damage. windthrow. and minor landscape damage.

On individual plots representing single stands a narrow class range may be present. but when a large number of stands are examined a simple relationship is found between plant size and density. Examination of this relationship in Puketeraki. Oxford and Mt Thomas forests is able to show short-term deer impact on replacement in two of these forests.

Deer damage can be seen as a minor disturbance factor compared with windthrow and disease damage. Even at high deer densities browse impact has placed only minor constraints on replacement in simple mountain beech forest over much of the region.

A SYSTEMS PERSPECTIVE OF DISTURBANCE

E.G. White

Current hierarchical concepts of ecosystems provide a holistic perspective on disturbance phenomena. Organised systems function with constraints (feedbacks) that may be characterised by their process rates. Slower-acting processes constrain faster-acting processes to limit system behaviour. in the manner of a hierarchical framework. Disturbances arise when a change in process rates destabilises the system at one or more points.

The degree of disturbance impact and the nature of impact depends firstly on the process rate of the disturbance agent itself. It also depends on the temporal and spatial scales of the system. A disturbance over the short term. or in small space. may not constitute disturbance in the longer term or in larger space. A disturbance event is therefore not an absolute phenomenon but a relative phenomenon. changing with different observer perspectives. When account is taken of observation parameters. the phenomenon can be characterised more clearly.

The characterisation of disturbance will be illustrated by numerous ecological examples.

HOW IS ANTHROPIC DISTURBANCE TO BE ACCOMMODATED IN LANDSCAPE ECOLOGY AND NATURE CONSERVATION?

Kevin F. O'Connor and Simon R. Swaffield

Significant anthropic disturbance of ecological systems has been increasingly perceived as the discipline of landscape ecology has emerged from varied sources in Europe and North America. In general this perceived significance has arisen from the ambitions of proponents of landscape ecology to develop for actual real-world systems an understanding that took account of each explanatory variable in turn and was at the same time holistic. In part. this increased significance arose from the widespread attempts to contrast natural and cultural landscapes. In part. the increased perception of significance has arisen from the failure to explain supposedly natural landscapes by non-human factors. Such a situation is also found in New Zealand.

Difficulties occur in accommodating anthropic disturbance in any general theory or methodology of landscape ecology, varying with the conception of landscape and especially with the preconception of mankind's separateness from nature or its immersion in it. The advantages which New Zealand may have for such studies and understanding, arising from its comparatively recent human influence, are offset by the complexity of physical landscape processes.

New Zealand initiatives for nature conservation and especially for the protection of natural areas in recent years have had considerable stimulus from conceptual work promoted through the Biological Resources Centre. This work has introduced a role for landscape ecology in the interpreting of ecological districts as a basis for representativeness in nature conservation. At the same time such work has conceived of such district or landscape dimension as those of human habitation, work, and belonging.

This paper examines some of the more critical intellectual and practical issues involved in such approaches where human belonging and disturbing are simultaneously predicated of the same real-world systems. The implications for promotion of conservation and especially of public participation in conservation are examined.

THE INVASION OF LAKE TAUPO BY THE SUBMERGED WATERWEED *LAGAROSIPHON MAJOR:* IMPLICATIONS FOR THE NATIVE FLORA

Clive Howard-Williams

The waterweed *Lagarosiphon major* (Hydrocharitaceae) was first recorded in Lake Taupo in 1966, and by 1979 it had occupied most, if not all, potentially colonisable sites in the lake. The invasion pattern of *L. major* in Lake Taupo showed that the barriers to its spread were almost entirely non-botanical. Correlations of the distribution of this plant with sediment type, water depth, slope, aspect, and exposure to wave action showed that the latter was the most important variable controlling its ultimate distribution. In ideal conditions, *L. major* forms tall monospecific stands which eliminate the native flora, over a depth range of 1 to 6.5 m. Very few species-rich stands of native aquatic plants now exist in Lake Taupo. Until now the human-related niusance value of *L. major* has attracted considerable attention, but the implications of the spread of this species for the conservation of the indigenous flora in this and other lakes have been overlooked.

THE IMPACT, PAST, PRESENT, AND FUTURE OF LING HEATHER *(CALLUNA VULGARIS)* ON PLANT COMMUNITIES IN TONGARIRO NATIONAL PARK

Hazel M. Chapman

Ling heather was first introduced to Tongariro National Park in 1912. Areas of red tussock *(Chionochloa rubra)* grassland were burnt and heather sown and planted. Until the early 1970s the distribution of heather remained generally within its original boundaries on the western side of the Park. It has now replaced much of the red tussock grassland in the Park and is a constituent of a wide range of other native and exotic plant communities. Future spread appears to be limited by environmental factors such as altitudinal limits and soil type, exclusion from established woody plant communities, and by more aggressive woody species becoming established amongst stands of heather.

CLEMATIS VITALBA: AN INVADER OF DISTURBED ECOSYSTEMS

Carol West

'Otherwise (apart from primary colonisation sites), the disturbance in the natural system that almost always seems to be necessary for plant invaders to be successful is caused by human activities' (Baker, 1986).

Clematis vitalba L. (old man's beard) was introduced into New Zealand as a garden plant; by homesick immigrants. This deciduous vine was first apparent as a naturalised plant in the late 19205. It occupied urban 'wasteland', hedges, and reverting cleared land around urban centres. It established along rivers from water-bourne seed while wind-dispersed seed allowed colonisation further from urban centres and homesteads. People cut back vines in their gardens and carried vegetative material to rural roadsides where they dumped it. Today C. *vitalba* is a

serious problem in many reserves, along many rivers, and impinges on five National Parks in the central part of the country. This vine is capable of destroying fragmented forest and riparian vegetation.

C. vitalba has many attributes of a colonising plant: high reproductive capacity; small, easily dispersed seeds; short-term persistence in the seedbank; high light demand; and fast growth rates. Unlike many colonising plants, it has well-developed vegetative reproduction and can occupy a site indefinitely. Features of the biology of C. *vitalba* that lead to its success as an exploiter of disturbed ecosystems will be discussed.

THE WAIKAIA ECOLOGICAL REGION: RESULTS OF PROTECTED NATURAL AREA SURVEYS OF THE UMBRELLA AND NOKOMAI ECOLOGICAL DISTRICTS

Katharine J.M. Dickinson

Comprehensive ecological surveys of the 150,000 ha Umbrella Ecological District and 116,000 ha Nokomai Ecological District in western Otago/northern Southland were conducted in 1985/86 and 1986/87 respectively. The two districts comprise the Waikaia Ecological Region.

Detailed study was made of areas representative of each district's indigenous plant associations, fauna, and landforms which had the highest natural values available, and presented the greatest contiguous sequences. Approximately 500 plots document the range in vegetation types. These fall within the lowland, montane, subalpine, low-alpine, and high-alpine bioclimatic zones.

Generally, land modification is least above 1000 m elevation. Below these altitudes sites of high natural value tend to be fragmentary. Nevertheless, the region possesses a rich and diverse biota and several plant and animal species reach a geographic limit within it, particularly in the alpine zone. A number of species of restricted distribution also occur here.

From the data collected, subsequent analyses and interpretation, Priority Places for Protection (PPPs) have been identified such that the region's remaining indigenous ecosystems are fully represented. These PPPs are additional to, and complement, three existing protected areas within the region, which predominantly protect forest habitats. Given the substantial land development in both districts, most of the areas identified are in the uplands. An outline of these will be given.

THE STATUS OF ECOLOGY OF KOWHAI NGUTU-KAKA *(CLIANTHUS PUNICEUS)* AT LAKE W AIKAREMOANA, UREWERA NATIONAL PARK

W B Shaw and B R Burns

Kowhai ngutu-kaka is a well known indigenous shrub prized for its horticultural value. It is, however, endangered in the wild, currently known to occur at only 26 locations, 18 of which are in Urewera Nationa Park, 16 within the Waikaremoana catchment. Two types of site are favoured by kowhai ngutu-kaka: partially vegetated rock bluffs; and shrubland that has developed following either burning or the lowering of Lake Waikaremoana in 1946 for hydro-electricity production.

Following concerns expressed by park managers, a project was initiated with the following objectives:-
1. To establish the status of remaining populations.
2. To gain a basic understanding of the ecology of kowhai ngutu-taka.
3. To identify threats, if any, to its survival in the wild.
4. If necessary, to devise management strategies to ensure the survival of wild populations of kowhai ngutu-kaka.

The project is still in progress, but some observations and preliminary results are presented. Once established on a site, kowhai ngutu-kaka commonly spreads vegetatively by layering. Plants also establish from seed. Although the present survey has revealed additional individuals, the number of genomes forming wild populations may be relatively small. Most populations at Waikaremoana are in seral communities, and although regeneration of kowhai ngutu-kaka is occuring, changes in vegetation structure and composition will probably lead to a need for active management to maintain this species on these sites.

THE DIVERSITY AND CONSERVATION STATUS OF PAKIHI VEGETATION IN NORTH WESTLAND

P.A. Williams, S.P. Courtney, D. Glenny, G. Hall

Twenty-eight areas of pakihi vegetation in 7 Ecological Districts in north Westland were sampled using non-area plots and analysed by TWINSPAN and DECORANA. Soil profile data and manuka stem ages were recorded. Twelve plot groupings were identified ranging from forest to scrub and open herbaceous vegetation. The main factors determining the regional patterns are drainage, nutrient status, and fire frequency. Most pakihi areas supported forest, many of them in European times. They are being invaded by manuka, which in turn is being invaded by potentially taller tree species.

Pakihi bird species are either characteristic of higher altitudes, widespread, or more common at lower altitudes, or widespread. The lower altitude species include many of the more distinctive pakihi birds more common in open pakihi. In contrast, fernbirds which have been a major stimulus for conserving pakihi, prefer structurally complex vegetation. This raises questions for management of pakihi reserves. There are many good reserves, but there is potential for improving the regional coverage.

PERMEABILITY OF PROTECTED NATURAL AREAS TO PROBLEM PLANTS

Susan M. Timmins[1] and Peter A. Williams[2]
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Weeds are increasing in New Zealand's protected natural areas as the natural landscape is fragmented and land use intensifies. There are presently about 75 species that are considered to be problem weeds (Timmins & Williams, 1987). We attempted to determine the most important factors influencing the susceptibility of forest and scrub reserves to invasion by problem weeds. The data set was derived from 3 surveys of scenic and allied reserves: Auckland (Gardner et al., 1981); Taranaki (Clarkson & Boase, 1982); and Marlborough Sounds (Walls, 1984).

Weediness was related to 14 reserve characteristics, using correlation coefficients and regression equations: size, shape, setting, i.e., surrounding land use, proximity to nearest town, proximity to railways and roads, presence of flowing water, soil fertility, fire history, presence of rubbish, proportion of woody vegetation, presence of clearings, stock use, and human use. About half the parameters are significantly correlated with weediness in at least one region. Results suggest the most important factors influencing the weediness of reserves are proximity to towns, and the setting. These are both a reflection of intensifying land use. The most vulnerable reserves are small, narrow remnants, with clearings, on fertile soils, and close to towns. These require close monitoring for plant species known to be problem weeds, and those whose weed potential has yet to be demonstrated.

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EFFECTS OF OVERSTOREY DIEBACK ON UNDERSTOREY LIGHT ENVIRONMENT AND SEEDLING PHOTOSYNTHESIS IN *NOTHOFAGUS SOLANDRI* VAR. *CLIFFORTIOIDES*

David Y. Hollinger

Dieback of *Nothofagus solandri* var. *cliffortioides*

(mountain beech) in the Craigieburn Range associated with *Platypus* beetle and fungal invasions has produced a forest with a very heterogeneous canopy. The understorey light environment was quantified in six stands of mountain beech experiencing a range of dieback. Not only did the total quantity of light reaching the forest floor increase with a decrease in canopy cover, but the temporal characteristics (duration and frequency) of understorey sun flecks also varied in a regular manner as coverage decreased. The change in light environment due to dieback results in increases in seedling photosynthetic carbon gain. Carbon gain increases because of a direct photosynthetic response (increased light), more favourable light dynamics (longer sunflecks with shorter intervals between), and long-term increase in seedling photosynthetic capacity.

THE STRUCTURE AND COMPOSITION OF TWO FORESTS BURIED BY THE TAUPO ERUPTION

Beverley R. Clarkson, Bruce D. Clarkson, Raj N. Patel

Reconstructions of forests buried by the c. AD 130 Taupo eruption were based on plant macrofossils collected mainly from two mires at Pureora and Benneydale, central North Island. The forests were dominated, by rimu, with tanekaha a major canopy component at Pureora whereas northern rata was frequent at Benneydale. Overall species compositions were similar with differences attributed to altitude and climate. Present-day forests adjacent to the sites are significantly different in composition to buried forests. They have a large component of the broadleaved species tawa, kamahi, and mahoe, none of which was represented in the macrofossils recovered. On the other hand, several buried forest species do not grow in adjacent today. The AD 130/ AD 1986 vegetation differences are attributed to many factors, including volcanic devastation, improved soil drainage, aeration and fertility, and possible deterioration of climate.

HABITAT USE BY COCKROACHES IN KANUKA-BEECH FOREST

Mary E. McIntyre

Monthly live-trapping data show well-defined annual cycles of abundance in a mixed population of indigenous cockroach species. Seasonal changes in size and sex classes indicate movements both on tree trunks and on the ground, and differing patterns of habitat use by males and females. Summer population peaks are caused by dispersal from overwintering sites, particularly by the long-lived adults. Despite extensive co-occurrence of the species, there is evidence for microhabitat partitioning in the use of shelter sites, and also for the vertical stratification of nocturnal activities on vegetation. Analyses of crop contents show that they are opportunist and relatively unselective feeders. Food sources include fungus, wood, epiphylls, and arthropod material. Circumstantial evidence suggests that honeydew may also be important, but this is difficult to detect. Differences between species in the frequencies of food items correlate with differences in microhabitat.

MOVEMENTS, DIET, AND BREEDING OF NEW ZEALAND PIGEONS

M.N. Clout, P.D. Gaze, and B.J. Karl

A radio-tracking study of the biology of New Zealand pigeons *(Hemiphaga novaeseelandiae)* at Pelorus Bridge Scenic Reserve, Marlborough has been in progress since 1984. Radio-transmitters have now been attached to over 30 different individuals, yielding information on diet, seasonal movements and breeding. New Zealand pigeons at Pelorus Bridge fed on foliage from August to December and various native fruits from January to July, relying especially heavily on fruits of miro *(Prumnopitys ferruginea)*. Approximately half of the pigeons captured whilst foliage feeding at Pelorus Bridge in spring moved to sites 3-14 km away in early summer, with the onset of breeding. At least some of these birds had returned by the following spring. The breeding success of pigeons resident in the study area varied greatly between years, due to rat predation and the possible influence of annual variation in the availability of fruit.

VEGETATION QUALITIES AND WHITEHEAD STOCK SIZE

John L. Craig and Neil D. Mitchell

Productivity and group size of communally breeding

birds is often considered in terms of the numbers of non-reproductives available to help the breeders. An alternative viewpoint is that group size is largely a consequences of habitat quality. In other words, groups in quality or more diverse habitat can raise and support more young and hence are largest.

This study attempts to correlate various measures of habitat with the size of groups of whiteheads on Little Barrier Island. Aspects considered include altitude, canopy height, structural and species diversity as well as indicator species.

DEER DIET ON STEWART ISLAND, AND ITS SIGNIFICANCE IN RELATION TO THE IMPACT OF DEER ON NEW ZEALAND FORESTS

G. Nugent and C.N. Challies

Based on the analysis of 160 rumen samples from northeast Stewart Island, white-tailed deer *(Odocoileus virginianus)* relied mainly on the fruit and foliage of trees and climbers that typically grew above the reach of the deer. Broadleaf *(Griselinia littoralis)* and supplejack *(Ripogonum scandens)* together comprised over 50% of annual diet, with much of this material being eaten only after it had fallen from the canopy. Seedling material appeared to be an unimportant component of diet, the deer population being sustained largely by plants that established prior to the deer invasion 60-80 years ago. The interaction between deer and forest plants may therefore require several more centuries to reach a stable equilibrium, at which point deer carrying capacity will be much lower that at present.

POPULATION GENETICS OF THE BRUSH-TAIL POSSUM

Susan Triggs

The genetic relationships among and within possum populations both throughout New Zealand and on a local scale were examined using allozyme electrophoresis.

Two morphological types were introduced to New Zealand: smaller, grey possums from mainland Australia; and larger, black possums from Tasmania. These two main stocks are non-randomly distributed in New Zealand; relationships were found between stock type, genotype, coat colour, and climatic variables.

The genetic structure of a local possum population (in the Orongorongo Valley, near Wellington) was analysed using F-statistics. Significant geographic structuring occurred over distances of several kilometres; samples separated by 2 km were essentially panmictic. Effective population size was very approximately estimated by genetic and ecological methods to be of the order of 10^3-10^4. The significant level of inbreeding found within local populations was consistent with consanguineous mating, presumably resulting from the non-dispersal of a high proportion of young (particularly female) possums.

THE DISTRIBUTIONS AND ABUNDANCE OF *VESPULA* WASPS IN NEW ZEALAND

K. Clapperton, G.R. Sandlant and H. Moller

We present the results of a nationwide postal survey of *Vespula* wasps in New Zealand. Trap and swat samples were also taken in the northern South Island. The distributions and comparative numbers of *Vespula germanica* and *V. vulgaris* are described. We investigate the variations in comparative numbers of the two species with time of year, latitude, altitude, and habitat.

EFFECTS OF FERAL HONEY BEES AND WASPS ON HONEYDEW

P.D. Gaze, H. Moller, B.W. Thomas, and J.A. Tilley

Exclosure experiments near Nelson show that feral honey bees *(Apis mellifera)* have a small effect on the number, size, and sugar concentration of honeydew drops. Bees give up feeding on honeydew during the late summer and autumn. when huge numbers of wasps appear. Exclosure experiments reveal a dramatic decrease in honeydew due to wasps feeding. The impacts of bees and wasps on South Island beech forests are discussed.

FEEDING ENERGETICS OF KAKA IN SOUTH ISLAND BEECH FOREST

J.R. Beggs and P.R. Wilson

Radio-equipped kaka *(Nestor meridionalis meridionalis)* studied in Big Bush State Forest spent 35% of their feeding time digging out *Ochrocydus huttoni* larvae. The larvae had a high energy value (34 kJ/g), and 91% of this energy was assimilated. However, the cost of digging out one *O. huttoni* meant that kaka made a net loss of energy.

In the beech forests in our study area, honeydew is the only high-energy food eaten by kaka that is produced throughout the year. Kaka gleaned 175 droplets per minute, and assuming 100% assimilation efficiency, made a large net gain of energy when feeding on honeydew.

If kaka in our study area rely almost entirely on honeydew to balance their energy budget, and *O. huttoni* for most of their other nutrients, then anything affecting either of these resources may have serious implications for the long-term survival of kaka in this habitat.

MOVEMENTS AND HABITAT USE BY KAKA *(NESTOR M. MERIDIONALIS)* IN SOUTH ISLAND BEECH FORESTS

P.R. Wilson, J.R. Beggs, and B.J. Karl

Twenty-three kaka, captured at two sites in Big Bush State Forest and one site in Nelson Lakes National Park, were radio-equipped then followed and located by ground tracking and remote radio telemtry (including aerial radio tracking).

This paper examines the differences in seasonal and diurnal movements by male and female kaka in relation to habitat use and availability of various food resource in the forests of this region.

A COMPARISON OF LIFE FORMS OF NEW ZEALAND ALPINE PLANTS WITH THOSE OF THE ANDES

Stephen Halloy

It has long been known that the New Zealand flora shows considerable affinity with that of South America, particularly the Subantarctic Biogeographic Province. It is less well known that this affinity extends, to a lesser degree and with a large disjunction, to the equatorial Paramo Province. Do life forms and vegetation show comparable similarities?

To answer this question, life form parameters (including whole plant, leaf group, leaf, stem architecture, roots) from alpine plants of the southern South Island of New Zealand are compared with those from three areas of the Andes: equatorial paramos; subtropical high-andean; and temperate alpine (Tierra del Fuego). Climatic parameters were taken to test their relation to life form. The enormous area and variability involved make this only a pilot study.

Tussock-shrubland communities of the low alpine zone of New Zealand seem to show the closest similarity in vegetation and life forms to the Paramo Province, rather than to alpine Tierra del Fuego at more similar latitudes. The high alpine zone of New Zealand seems to show the closest similarity to the subtropical high-Andean Province, particularly cryptofruticetum communities of the Cumbres Calchaquies. Details of these comparisons will be outlined.

MAST SEEDING BY THE DIOECIOUS TEMPERATE FOREST TREE *DACRYDIUM CUPRESSINUM (PODOCARPACEAE)* IN NEW ZEALAND

David A. Norton and David Kelly

A 33-year series of data on seed production in *Dacrydium cupressinum* (rimu), a common wind-pollinated tree in the lowland and lower montane forests of New Zealand, shows mast seeding. Six of the 15 mast years followed immediately after other mast years. Warm temperatures in the summer of seedfall and low seed production two years previously are necessary, but not sufficient, conditions for the occurrence of a mast year. The interaction of seedfall in one year with that two years previously is linked to the long reproductive development period in rimu; seed ripens two years after the reproductive structures are initiated. This provides a clear example of competition between overlapping cohorts of reproductive structures in the same plant. Mast years showed higher percentages of sound seed as well as higher total seed crops per unit area.

The two existing hypotheses which could account for mast seeding (predator satiation and resource limitation) are discussed. We suggest that resource

limitation cannot account for observed cases of mast seeding and predator satiation is only one of a group of possible causes (efficiencies of scale). For example, wind pollination could also provide efficiencies of scale; thus we would predict that wind-pollinated trees are likely to be mast seeding. In rimu, wind pollination could be important, while predator satiation seems less likely as a selective pressure.

In common with other New Zealand podocarp trees, rimu has bird-dispersed seeds. The prediction that mast seeding is unlikely to occur in trees with animal-dispersed seed (Silvertown, 1980) is not supported by the results of this study. The reason for this discrepancy appears to be that the bird species dispersing rimu seed are generalist feeders.