

## ANNUAL CONFERENCE 1986

The 35th Annual Conference was held at Lincoln College from 2-5 September 1986. There was an above average number of registrants (210). The conference began for many on Monday 1 September with a new-look, muddy boot field trip, a one day survey of Kowhai-Lords Bush led by Dr Colin Meurk. This was an interesting and enjoyable way to begin the week's conference activities and a style of field trip worth repeating. The symposium on Moas, Mammals and Climate was very successful, integrating a diverse range of scientific fields. Contemporary thinking on the subject of the symposium was summarised in a thought provoking two day programme expertly introduced by Graeme Caughley's initial review.

The general conference programme was as follows:

Tuesday: Symposium.

Wine and Cheese evening including a debate.

Wednesday: Symposium

Poster Session

Workshops

Symposium synthesis

Annual Dinner

Thursday: Contributed papers

Excursion to Canterbury Museum

AGM

Friday: Contributed papers. Papers presented at the symposium were:

G. Caughley: Introductory review.

McGlone: Vegetation and climatic change over the past three millennia.

Grant: A model for the late Holocene histories and interactions of climate, erosion, alluvial sedimentation, vegetation, polynesians and animals.

McFadgen: Depositional episodes in late Holocene coastal deposits in New Zealand.

McSaveney and Whitehouse: Anthropogenic erosion in the Canterbury mountain lands.

Basher, Tonkin and Daley: Erosion and plant succession in a high rainfall area of Central Westland.

Holdaway and Brathwaite: New Zealand's prehuman avian ecology: a scenario.

Luckens: Habitat preferences of Dinornithiformes deduced from gastrolithic evidence.

Atkinson and Greenwood: Moa-plant relationships.

Duncan and Holdaway: Footprint pressures of moas and ungulates.

Clout and Hay: The importance of avian herbivores in New Zealand forests.

Brathwaite and Holdaway: A reconstruction of *Harpagornis moorei*, top predator in the moa world.

Bathgate: Downturn in rimu (*Dacrydium, cupressinum*) recruitment and diameter growth between 1700-1900 AD.

Stewart and Rose: Age structure and regeneration dynamics of *Libocedrus bidwillii* stands, Camp Creek, Westland, New Zealand.

Norton and Ogden: Review of NZ dendrochronology in relation to past climates.

Payton: The role of possums in rata-kamahi forest mortality in Westland.

Rose and Platt: Composition and distribution of alpine grassland communities of Wapiti Lake, Fiordland, N.Z.

Wardle, Stewart and Burrows: Modification of pristine Fiordland forests by deer and vegetation recovery following control.

Mark: Vegetation responses under opposing trends of red deer influence in two habitats in S. W. South Island.

The excursion to Canterbury museum on Thursday afternoon was informative and complemented the symposium papers. A moa/man presentation was hosted by Michael Trotter, Beverly McCulloch and Colin Burrows and participants were able to handle moa bones and see reconstructions of the birds.

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. Many stimulating discussion started there. Posters were prepared by:

Blaschke: Vegetation-site relationships in inland Taranaki hill country.

Davis and Bellingham: Mapping of estuarine vegetation in the Hokianga.

Fraser: Reproductive biology of the rabbit In Central Otago.

Halloy, Keogh and Vides: Devaricating shrubs: an outside perspective.

McEwan: BRC's directory of people with knowledge about the biology of various ecological districts.

Mitchell: A new approach to interpreting species climate interaction.

Montague: Little penguin food studies.

Parkes: The diet of feral goats from adjacent high and low density herds in the Motu River, Raukumara State Forest Park.

Simpson and Myers: WERI (Wetlands of Ecological and Representative Importance) - The New Zealand Wetlands Inventory.

Spurr: Effect of 1080 poisoning of possums on bird populations in Westland National Park.

Thomson: Diet of feral pigs in Urewera National Park. Tilley and Moller: Honeydew.

Various: Deer-vegetation-soils of Fiordland.

Wardle: Divaricating shrubs.

Williams: The dynamics of managed rabbit populations on pastoral farmland.

The workshops on Wednesday afternoon, run concurrently, were very well attended. The nature of some of the topics meant that we could have spent a day on each alone rather than the scheduled one and a half hours. All prompted discussion and further action. Workshop topics were:

1. The contribution of science to wild animal management. Led by Peter Logan.
2. Measuring vegetation as animal habitat. Led by John Leathwick.
3. The new high school biology syllabus. Led by Eric Scott.
4. In)stability of botanical nomenclature. Led by Dave Kelly.

Papers presented in the contributed papers sections on Thursday and Friday were:

McQueen: Browsers and growth form of shrubs.

Batcheler: Evidence of moa browsing from the distribution of deciduous and toxic woody plants.

Horn: Moa tracks: an extant legacy from an extinct species.

Collins: The relationships between landform, soils and vegetation in South Westland terrace rimu forests.

Merton: The ecology of two south Westland pakihī mires.

Baxter: Secondary succession following logging in West Coast terrace rimu forests.

Bray and Burke: Forest regeneration dynamics in Golden Bay, New Zealand.

Watt: Pine invasion in indigenous forest.

Keenan: The ecology and management of *Nothofagus* spp. and *Libocedrus bidwilli* on Banks Peninsula.

Dzięciolowski: Wildlife research planning and coordination-A European perspective.

Fraser: Rabbits in Central Otago-what is the real problem?

Challies: Are the white-tailed deer on Stewart Island controllable?

Murphy: The effect of supplementary feeding on mainland and island populations of mice in the Marlborough Sounds.

Mills, Lee and Lavers: Competition and interaction between deer and takahe for food in Fiordland.

Montague: The management of black swan (*Cygnus atratus*) damage using behavioural models.

Davis: Demography of the N.Z. shore plover population of Rangatira Island.

Burrows: Seed trapping in lowland forest.

Moller and Tillery: Honeydew and its use by birds and insects.

Timmins, Atkinson and Ogle: Management of Mana Island, Wellington as a 'nature park'.

In all, a good balance of subjects was covered in the contributed papers and interest sustained to the last.

The wine and cheese evening featured a new innovation, an Oxford Union style debate which was very entertaining for all and something to be retained in future years.

The 1986 Conference was ably organised by Mike Butcher with help from other Christchurch ecologists and Lincoln College. The great success of the conference was due to the hard work and organisational abilities of these people and Mike Rudge who conceived and executed the idea of the symposium. The success was also due to the people who contributed papers, posters and workshops who put 'sufficient meat' on the 'programme bones' to generate and maintain interest.

Abstracts of papers presented are listed below. Some appear in the Journal, and others are being published in a separate symposium volume.

#### NEW ZEALAND PLANT- HERBIVORE SYSTEMS: PAST AND PRESENT

G. Caughley

The history of the New Zealand biota over the last 8000 years may be divided into three phases. BC 6000 to AD 1000 was a period of comparative ecological stasis. That equilibrium was disrupted between AD 1000 and AD 1800 by the destruction of most of the New Zealand plant-herbivore systems, the evolutionary relationship between the plants and the vertebrate herbivores being decoupled by about AD 1400. After AD 1800 new plant-herbivore systems were progressively developed and new ecological relationships forged. Our view of that past, and of how the future might best be managed, has less to do with those facts than with judgements of value.

#### VEGETATION AND CLIMATIC CHANGE OVER THE PAST THREE MILLENNIA

M.S. McGlone

Climatic change, natural and anthropogenic fire, and

volcanic eruptions have profoundly affected vegetation in nearly all places within New Zealand. It is against this background of radical environmental alteration that the effects of moa and introduced mammals must be judged. At present, there is no fossil evidence which permits an assessment of the effects of moa as distinct from other non-biotic factors.

### A MODEL FOR THE LATE HOLOCENE HISTORIES AND INTERACTIONS OF CLIMATE, EROSION, ALLUVIAL SEDIMENTATION, VEGETATION, POLYNESIANS AND ANIMALS

Patrick J. Grant

During the last 1800 years there have been eight major periods of erosion and alluvial sedimentation. The last seven were associated with increased northerly airflow and atmospheric warming over New Zealand, resulting in increased storminess and flooding. In each period, vegetation was severely depleted and locally destroyed. In the tranquil intervals between, vegetation established on the new bare surfaces. This periodic vegetation damage and renewal, into very recent times, means that much of it is relatively young. Even in the absence of Man and animals, this vegetation would still be in a dynamic state of imbalance and change.

A chronology is presented, different climate regimes are characterised in terms of vegetation response, and some management implications are stated.

### ANTHROPIC EROSION IN THE CANTERBURY MOUNTAIN LANDS

M.J. McSaveney and Ian E. Whitehouse

Man-induced, or anthropic, erosion can be recognised in the Canterbury mountain lands. It is obvious where associated with roads, tracks or fences, but less obvious when the association is less direct, as with erosion caused by vegetation depletion following fire or overgrazing. Early surveys reported significant and widespread anthropic erosion. Recent research is changing this perception of placing anthropic erosion in context with natural erosion which is more significant and more extensive than early surveys recognised, and highly variable in space and time. The

highest sediment yields and erosion rates in Canterbury are within the wetter and often well forested areas near the main divide rather than in the drier, depleted eastern ranges. In the latter region, some barren screes are old and stable features, changing little over centuries, and even very active unstable screes may be old landforms. Studies of soil stratigraphy have provided a long history of episodic stability and instability. Dated charcoals from the soils have provided a history of fires spanning the last 6500 years. From 500 to 1000 years ago, there was widespread deforestation by fires. Early pastoralists increased the frequency of fires and, with sheep-grazing, further modified and depleted the vegetation. From experiments with clearing forested basins a regional increase in erosion rates also would have increased during early pastoral occupation as measured sheet erosion is greater from bared areas than from areas with intact tussock or scrub cover. Widely distributed grassland transects show little significant overall change in bare-ground area in the last 10-35 years. Detailed repeated photographs near Porters Pass show both increases and decreases in bare ground rather than a general trend over the last 90 years. We interpret the responses to the last 100 years of pastoral management of the Canterbury mountain lands to be within the natural variability of erosion rate and form for the area.

### EROSION AND PLANT SUCCESSION IN A HIGH RAINFALL AREA OF CENTRAL WESTLAND

L.R. Basher, P.J. Tonkin, G.T. Daly

Cropp River is a 28.5 km<sup>2</sup> drainage basin in the zone of maximum precipitation (10,800 mm y<sup>-1</sup>), uplift (12±mm y<sup>-1</sup>) and erosion rates (11±1 mm y<sup>-1</sup>) in the central Southern Alps of New Zealand. The basin is intensely dissected and mainly comprises steep (30-70°), rectilinear slopes with thin (<2 m) regolith. The area formerly had high populations of deer and opossums but numbers are currently low.

Very high rates of surface soil erosion occur under a dense vegetation cover of rata-kamahi forest, subalpine scrub and *Chionochloa* grasslands. Erosion and natural revegetation in the subalpine scrub zone are described. Episodic slope failures occur frequently. Revegetation of eroded sites is rapid, despite low soil nutrient status. Species composition changes rapidly in the first thousand years of plant succession but thereafter changes are more subtle. Because of the

rapid revegetation and plant succession on denuded sites obvious visual evidence of high erosion rates is short-lived. The development and distribution of soils indicate a long history of high erosion rates.

Extreme precipitation and uplift cause rapid erosion at Cropp River. The presence of dense vegetation cover over most of the landscape, up to the limits of plant growth, reflects adaptation to frequent disturbance. A knowledge of natural rates of erosion is a prerequisite to understanding the actual or potential effects of introduced animals on erosion rates.

### NEW ZEALAND'S PREHUMAN AVIAN ECOLOGY: A SCENARIO (WITHOUT MOAS)

R.N. Holdaway and D.H. Brathwaite

Discussions of the ecology of the prehuman avifauna in New Zealand have concentrated on moas.

Examination of other species, whose ecologies can be at least partially inferred from their structure and relationship to extant species, may give valuable insights into the kind of habitats, and hence vegetation types, present before human occupation.

This paper discusses possible niches for *Cnarmiornis*, *Euryanas*, *Oxyura*, *Biziura*, *Pelecanus*, *Megaegothales*, 'Circus', *Aptornis*, *Gallinula*, *Capellirallus*, and *Corvus*, including their habitat requirements, food, and the probable ground fauna of the time. An open forest floor and areas of riparian sward were probably important for several of the species.

### HABITAT PREFERENCES OF DINORNIFORMES: GASTROLITHIC EVIDENCE

J.B. Luckens

A preliminary study shows that, in the main, moa lived and died on the drier, more sparsely vegetated areas, usually ridges and rear dunes. Why this was so is discussed, as well as the problems associated with the study of gastrolithic evidence. This includes materials, weights, numbers, size, wear rates, durability, locality distribution, area density, dispersal, reconsumption, selectivity and possible ages.

### MOA-PLANT RELATIONSHIPS

Ian Atkinson and Michael Greenwood

The place of moas in the pre-Polynesian ecosystem

cannot be understood without some knowledge of their physical characteristics and possible behaviour and some appreciation of their short-term and long-term effects on plants. Conclusions about these questions are used to construct a hypothetical model of what parts of the New Zealand ecosystem may have looked like when moas were present.

### FOOTPRINT PRESSURES OF MOAS AND UNGULATES

K.W. Duncan and R.N. Holdaway

The footprint pressures and foot edge loadings of 3 genera of moas and 2 feral ungulates were compared.

Whereas each foot of a moa must take 100% of the animal's weight during a step, an ungulate's forefoot will take about 60% and a hindfoot, 40%. For each completed stride, however, the hindfoot impression overlaps that of the forefoot so the substrate under the forefoot must also take most of the weight, as in the moa, but in two increments. The foot shapes differ markedly; the ungulate hoof is sharp-edged and (in bovids) bifurcate, the only resilience or conformance possible being a splaying of the nails which has a shearing or chiselling effect on the substrate; the toes of living ratites, and probably those of moas, have a rounded cross-section and they can both splay under load and flex vertically to conform to the substrate. Differences in potential damage to litter, soil, and surface roots are complex functions of total footprint pressure, edge loadings, shape and flexibility of the foot, frequency of impact within a stride, gross abundance of the animal and return time to a particular location.

### THE IMPORTANCE OF AVIAN HERBIVORES IN NEW ZEALAND FORESTS

M.N. Clout and J.R. Hay

New Zealand's forest plants have evolved in the absence of mammalian herbivores, but have been subject to the attentions of a variety of other animals over evolutionary time. Insects were (and still are) the primary folivores and pollinators, but birds may also have been important in both of these roles. Several extinct birds (notably moas) were herbivores and speculation continues about their impact on the vegetation. Among existing forest birds, both kereru (*Hemiphaga novaeseelandiae*) and kokako (*Callaeas*

*cinerea*) can significantly defoliate plants under some circumstances and may have had a more significant impact in the past. Beneficial interactions of birds with forest plants include pollination and seed dispersal. Flower visitation by honeyeaters and other birds seeking nectar has been recorded (Godley, 1979), but the importance of frugivory and seed dispersal by birds has hitherto been given scant regard. Over 70% of the woody plants in New Zealand forests have fruits suited for vertebrate dispersal, and of these most are probably dispersed by birds. The recent extinction of several frugivorous forest birds (e.g. moas, piopio, huia) and the current rarity of others (e.g. kokako) has reduced the number of potential seed dispersers, especially for large-fruited species, which now depend almost entirely on kereru for their dispersal.

#### A PRELIMINARY RECONSTRUCTION OF *HARPAGORNIS MOOREI*: TOP PREDATOR IN THE MOA'S WORLD

D.H. Brathwaite and R.N. Holdaway

A preliminary analysis of skeletal elements indicates that *Harpagornis moorei* was an immense forest eagle, similar in conformation to the *Spizaetus* eagles of South America and Africa, *Harpyja* of South America and *Pithecophaga* from the Philippines. The male *Harpagornis* weighed 9-10 kg and the female up to 16 kg. The structure of the feet and claws suggest that *Harpagornis* had an extremely powerful grip, in contrast to extant carrion feeders, and that it could not walk long distances. This, and the proportions of the wings, which would have precluded soaring, suggest that the eagle was a predator. Although the energy required for flight in such a large bird was near the limit available from the flight muscles, the supracoracoideus muscles powering the wing upstroke were disproportionately large and white muscle fibres probably dominated in the flight muscles. If so, even the largest individuals could have made short, rapid flights through the forest. This, and an ability to rise steeply from the ground, suggests that the bird was a sit-and-wait predator, able to overcome large prey and to defend a kill. Although it undoubtedly took carrion (or immobilised prey), this was probably not its primary role in the ecosystem. Other aspects of its ecology and biology are inferred from available allometric relationships.

#### DOWNTURN IN RIMU (*DACRYDIUM CUPRESSINIUM*) RECRUITMENT AND DIAMETER GROWTH FROM 1700-1900 AD

J. Bathgate

Analysis of 327 rimu stem discs provided ring-width trends for the last 700-800 years, independent of stem physiological age. Rimu chronologies all feature slow diameter growth in the 17th and 18th centuries AD. A subsequent upturn in growth corresponds with the increase in minimum air temperature recorded at Dunedin since 1853, suggesting a causal link. Similarly, several large inventories of rimu stem reveal significantly fewer survivors from some centuries in the 16th-19th century AD establishment period, than from immediately earlier centuries. It is suggested that climatic worsening from the 15th century AD could have adversely influenced rimu recruitment as well as diameter growth, a trend which reversed last century.

#### AGE STRUCTURE AND REGENERATION DYNAMICS OF *LIBOCEDRUS BIDWILLII* STANDS, CAMP CREEK, WESTLAND, NEW ZEALAND

G.H. Stewart and A.B. Rose

The idea that the podocarp regeneration gap was a logical consequence of the acceptance of classical climax theory was forwarded by Veblen and Stewart (1982). They considered that regeneration (or its lack) of *Libocedrus bidwillii* (one of the conifers considered to have a 'regeneration gap') was related to the history of natural physical disturbances. The present study follows on from this and documents the regeneration dynamics of *Libocedrus bidwillii* along a soils gradient in a geomorphically active drainage basin in Westland.

The first detailed age structures of individual stands in the subalpine zone are presented along with an interpretation of their history of development and current regeneration dynamics. Many *Libocedrus* established during the period of the postulated regeneration gap (c. 1500-1800 AD) as a result of mass movements. This supports the earlier Veblen and Stewart (1982) study, i.e. it is not necessary to invoke the climate change hypothesis to explain the present structure of stands containing *Libocedrus bidwillii*.

## THE APPLICATION OF DENDROCHRONOLOGICAL TECHNIQUES IN NEW ZEALAND: A REVIEW

D.A. Norton and J. Ogden

Despite early views to the contrary, considerable progress has been made over the last 10 years in applying dendrochronological techniques to New Zealand trees. This has resulted in the development of over 60 crossdated and replicated modern tree-ring chronologies from nine gymnosperm and angiosperm trees and two sub-fossil chronologies from *Agathis australis* and *Phyllocladus trichomanoides*. In four species groups (*Agathis australis*, *Libocedrus bidwillii*, *Nothofagus menziesii* - *N. solandri*, and *Phyllocladus glaucus* - *P. trichomanoides*) regional chronology grids have also been developed.

In this paper we first discuss the philosophy behind dendrochronology and describe the techniques that we are presently using in New Zealand. Particular attention will be given to some of the methodological problems encountered. We then review the results of dendrochronological studies in New Zealand looking in particular at the information that can be gained on past environments and the modern ecology of forest trees. Finally we outline where we see the future of dendrochronology in New Zealand.

## THE ROLE OF POSSUMS IN WESTLAND RATA-KAMAHI FOREST MORTALITY

I. Payton

Regeneration patterns in Westland rata-kamahi forests range from whole stand replacement (even-aged stands) after landslides to the replacement of small groups or individual trees leading to a mixed-age forest structure. Whereas young trees of southern rata, the major canopy species showing dieback in Westland, have relatively small crowns, mature trees are characterised by large rounded crowns.

Possum browsing of rata, which is largely confined to canopy foliage, opens up the canopy to wind and insect damage. The survival of leaf bunches after canopy opening is a measure of their size and degree of exposure.

Young even-aged rata-kamahi stands are observed to be most resilient to dieback. Loss of trees in these stands, whether by natural competition or possum

browsing, does not affect the ability of the stand to maintain a closed canopy. Loss of mature trees once this thinning process is essentially complete leads to the opening up of the canopy and subsequent damage to the stand by wind, fungi and insects. The survival of mixed-age stands following the loss of canopy trees depends on their ability to maintain canopy closure.

## RECOVERY OF ALPINE GRASSLANDS OF NORTHERN FIORDLAND AFTER A MARKED REDUCTION IN THE DEER (*CERVUS ELAPHUS*) POPULATION

A.B. Rose and K.H. Platt

A significant recovery of preferred food plants occurred between 1969 and 1984 on 57 permanent plots in the alpine grasslands of northern Fiordland after aerial hunting removed most of the introduced deer (*Cervus elaphus*) population. Deer showed a strong preference for grasslands characterised by *Chionochloa pallens*. These occur on fertile soils, and have shown the most recovery, especially at low altitude. Little change occurred in the less favoured grasslands characterised by *C. crassiuscula* and *C. acicularis* on infertile soils.

The vegetation preferred by deer is some of the best potential habitat of the takahe (*Notornis mantelli*), an endangered rail. Little competition from deer would occur if takahe were reintroduced on to these sites, providing intensive aerial hunting continued.

## INFLUENCE OF DEER ON THE FORESTS OF NORTHERN FIORDLAND

J. Wardle, G. Stewart and L. Burrows

Previously high deer numbers in northern Fiordland caused considerable changes to the composition and structure of the forests. The density of woody plants in the understorey was reduced in some areas by as much as 50% and shifts in composition occurred with preferred food plants becoming less abundant relative to those that were seldom eaten. However, the impact of these animals varied between different forest types. Seral communities, and forests at low altitudes, naturally had a high proportion of preferred food plants in the understorey, and types growing on these

sites were modified to a much greater extent than those growing at high altitudes and on poor soils.

Data gathered during a survey of the Wapiti, Doon and Glaisnock catchments of northern Fiordland during the 1984-85 summer indicated that pronounced recovery had occurred in the forest understorey following reductions in deer numbers. Densities of woody plants increased on average by at least 75% since previous surveys by the Forest Research Institute in 1969 and 1975. However, recovery was still largely confined to understorey tiers less than 75 cm high. Increases in tiers above 75 cm were small by comparison indicating that insufficient time had elapsed since deer numbers were reduced for recovery to be complete.

## RESPONSES OF INDIGENOUS VEGETATION TO SUSTAINED AND DECREASING UTILIZATION BY RED DEER

A.F. Mark

Results of continuing studies of vegetation responses to sustained levels of use by red deer on the rain forests of Secretary Island, Fiordland are contrasted with those related to substantially reduced deer numbers on the full range of mountain vegetation in Mt Aspiring National Park, South Westland-Western Otago.

Combined qualitative and quantitative assessments, including use of permanent quadrats, on Secretary Island have revealed a range of responses. The most palatable species have continued their serious decline due to either debarking of woody plants (*Pseudopanax colensoi* by chewing; *Phyllocladus aspleniifolius* by antler rubbing) or grazing of herbs (e.g. *Asplenium bulbiferum*). Accessible parts of palatable trees (e.g. *Griselinia littoralis*, *Coprosma lucida*) and shrubs (e.g. *C. joetidissima*) continue to be heavily browsed while leading stems of *Pseudopanax linearis* and juvenile *P. crassifolius* continue to be distorted as a consequence of removal of their terminal shoots. Some increases have also been noted, e.g. *Cyathea smithii*.

Photographic records and simple descriptions of c. 75 permanently marked sites representative of the six major vegetation types occurring in Mt Aspiring National park are assessed on the basis of three records spread over the period 1970-1986 when deer numbers have remained consistently very low. The order of increasing recovery of communities generally

has been from high-alpine fell fields and snowbanks through forests, subalpine shrublands and low-alpine snow tussock grasslands. Of the latter, midribbed snow tussock grassland and many of its associated species (*Chionochloa pallens*, *Ranunculus lyallii*, *Anistome haastii* in particular) have recovered dramatically while some previously prominent unpalatable or tolerant species (e.g. *Celmisia armstrongii*, *C. walkeri*, *Astelia nervosa*, *Poa colensoi*) have become less conspicuous. A range of individual cases will be discussed.

Vegetation stability has not yet been reached in either region. Possible future trends will be evaluated in relation to the likely influences of a more effective 1080 gel formulation for Secretary Island and a continued loss of commercial viability of wild animal recovery for the Mt Aspiring region.

## BROWSERS AND GROWTH FORM OF SHRUBS: ARGENTINA AND MEDITERRANEAN EUROPE

D.R. McQueen

In Argentina shrubs have been subject to raptorial and mammal pressure. A reconnaissance at lat. 40°S, from humid forest to arid shrub desert, showed that spininess was dominant and divarication less important. In Mediterranean Europe mammals alone are present. A seral dominant, *Quercus coccifera*, is divaricate and spiny; *Olea* and *Rhamnus* divaricate only. In N.Z. divarication alone may have been sufficient protection against raptorial.

## EVIDENCE ON MOA BROWSING FROM THE DISTRIBUTION OF DECIDUOUS AND TOXIC WOOD PLANTS

L. Batcheler

The most characteristic lower altitude seral indigenous forest shrubs are either deciduous or toxic.

These qualities are consistent with supposing the attributes to be defensive adaptations against browsing by moas, as they now are against browsing by introduced mammals. Alternative explanations, such as adaptation to winter cold, or defense against phytophagous insects, appear to be untenable.

## MOA TRACKS: AN EXTANT LEGACY FROM AN EXTINCT SPECIES

P. Horn

Evidence is presented suggesting that moas used tracks to expedite movement from place to place. Many of these tracks are still visible today. The use of tracks by moas is supported by comparisons with other ratites, and provides further evidence that the moa was a forest rather than grassland dweller.

## THE RELATIONSHIPS BETWEEN LANDFORM, SOILS AND VEGETATION IN SOUTH WESTLAND TERRACE RIMU FOREST

J. Collins

The vegetation and soils across a range of landforms in terrace rimu forest were assessed. Changes in soil morphology appear mainly related to drainage. Obvious changes in the vegetation, both with respect to canopy trees and ground cover (especially ferns), were also observed on different landforms. The relationships between these factors are discussed.

## THE ECOLOGY OF TWO SOUTH WESTLAND PAKIHI MIRES

P. Merton

The vegetation of two pakihi mires, one unburnt and the other partially burnt, is described and compared. Based on transect studies, the influence of fire and logging on the forest-pakihi ecotone is discussed. Reasons for the initial formation of these pakihi and the present stability of the forest pakihi ecotone are also discussed.

## SECONDARY SUCCESSION FOLLOWING LOGGING IN WEST COAST TERRACE RIMU

W. Baxter

Three areas selected on the basis of age since logging were assessed for regeneration patterns of native vegetation. It was found that the regeneration patterns were largely dependent upon the vegetation remaining

after logging rather than on the influx of plants from outside the site. The significance of this for the future composition of forests on these sites is discussed.

## FOREST REGENERATION DYNAMICS IN GOLDEN BAY, NEW ZEALAND

J.R. Bray and W.R. Burke

There is a rapid regeneration of forest following disturbance in the Aorere Valley, Golden Bay. We describe some time and space dynamics of this regeneration and note a present profusion of Podocarp saplings and seedlings.

## PINE INVASION IN INDIGENOUS VEGETATION

V. Watt

Invasion by several pine species of early to late successional indigenous vegetation on Maungakakamea (Rainbow Mountain) near Rotorua was examined. Results show that pines may establish in early successional shrubland vegetation but not in closed canopy tall shrubland and forest. Disturbance is shown to be a major feature of invasion.

## THE ECOLOGY AND MANAGEMENT OF *NOTHAFAGUS* SPP. AND *LIBOCEDRUS BIDWILLII* ON BANKS PENINSULA

S. Keenan

The present distribution of *N. fusca*, *N. solandri* and *L. bidwillii* on Banks Peninsula is described. All three species have very restricted distributions. In the case of *L. bidwillii*, the total population size has been severely reduced over the last 50 years. Based on our knowledge of the ecology of these species, prospects for the long-term management of the remaining areas are discussed.

## WILDLIFE RESEARCH PLANNING AND CO-ORDINATION: A EUROPEAN PERSPECTIVE

R.M. Dzieciolowski

Research planning and co-ordination as practised in some east European countries is presented. Research

areas are conceived and priorities established at ministerial level. Experts consult at this early stage of planning and the resultant draft is distributed among relevant research institutions for offers of participation. Construction of coherent research programmes for any field (e.g. game management), the next step in the process, seems to be crucial for the success of the programme. A flexible but uncompromising co-ordination throughout the project by an experienced and independent expert is also essential. Annual reports, presented at meetings of all participants, help in project co-ordination and the early detection of shortfalls. Budgets for subsequent years are approved only after satisfactory acceptance of previous annual reports. Job completion reports are audited and outstanding ones awarded prizes. Publications may follow.

### RABBITS IN CENTRAL OTAGO - WHAT IS THE REAL PROBLEM?

W. Fraser

The extent of the rabbit problem and the recent history of rabbit control in Central Otago are reviewed briefly. Results of an investigation into the causes of declining success rates of 1080 poison operations are reported, in particular the role of neophobic behaviour, and the implications for control strategies are discussed. The relevance of rabbit control in Central Otago is examined and several questions posed regarding the true nature of the problem.

### ARE THE WHITE- TAILED DEER ON STEWART ISLAND CONTROLLABLE?

C. Challies

White-tailed deer numbers on Stewart Island have remained high despite the efforts of recreational and commercial hunters. They are still having a major effect on the coastal forests. This paper describes the results of a natural bait poisoning trial undertaken to test the effectiveness of the method against these deer. It proved to be a practical and efficient means of quickly reducing deer numbers to very low levels.

### THE EFFECT OF SUPPLEMENTARY FEEDING ON MAINLAND AND ISLAND POPULATIONS OF MICE IN THE MARLBOROUGH SOUNDS

E. Murphy

The role of food as a limiting resource for mouse populations was evaluated in an island and mainland habitat in the Marlborough Sounds, using supplementary feeding. The effects on mortality, length of breeding season, rate of sexual maturation and growth are examined.

### COMPETITION AND INTERACTION BETWEEN DEER AND TAKAHE FOR FOOD IN FIORDLAND

J.A. Mills, W.G. Lee and R.B. Lavers

Both deer and takahe favour the most nutritious *Chionochloa* species in the alpine grasslands of Fiordland. Experimental manipulation of *Chionochloa pallens* indicates that takahe feeding stimulates tussock regrowth while deer grazing severely reduces tussock vigour. Results suggest that it will take at least 15 years for the grasslands to recover from the heavy deer use of the 1960's and early 1970's.

### THE MANAGEMENT OF BLACK SWAN (*CYGNUS ATRATUS*) DAMAGE USING BEHAVIOURAL MODELS

T. Montague

Models of Black Swans set in various postures can be useful tools in the management of where Black Swans graze. Black Swans can be attracted into selected areas using decoys while models of swans in flight can be used to repel birds if deployed in sufficient numbers in the area to be protected.

### DEMOGRAPHY OF THE N.Z. SHORE PLOVER POPULATIONS ON RANGA TIRA ISLAND

A. Davis

An analysis of 15 years banding data, a number of population censuses and two seasons of intensive field work.

### SEED TRAPPING IN LOWLAND FOREST

C. Burrows

The paper reports one year's trapping of seed fall in a mixed angiosperm forest stand. Mean seedfall densities, seed dispersal and some general conclusions of the study are to be discussed.

### HONEYDEW AND ITS USE BY BIRDS AND INSECTS

H: Moller and J.A.V. Tilley

Drops of beech tree sap on anal tubes of the honeydew scale insect (*Ultracoelostoma assimile*) are eaten by wasps, bees, tuis and bellbirds. Variation in honeydew and its use by the animals is outlined. The

spread of the common wasp has important consequences for beekeeping and conservation.

### MANAGEMENT OF MANA I., WELLINGTON AS A 'NATURE PARK'

S. Timmins, C. Ogle and I. Atkinson

It is proposed that 217 ha Mana I., which is very modified and largely in grassland, be turned into a 'nature park' to take advantage of its values and the opportunity it provides for protection of regionally threatened habitats, nationally threatened plants and animals. A revegetation programme modelled on that in progress at Titiri Matangi I. will be commenced shortly.