

SCIENCE AND RESEARCH INTERNAL REPORT NO.20

**SCIENCE AND RESEARCH PROJECT 1987-88
SUMMARIES 1987-88**

PART 1: Science and Research Directorate

Compiled by

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Wellington, New Zealand

July 1988

PREFACE

The report describes science and research activity within the Department of Conservation in the 1987/88 financial year. The work done externally under contract will be reported separately.

These report summaries are designed to describe the reasons for the work, highlight the important scientific findings and draw out the matters of interest to managers. Subject, location and status indexes assist in locating topics.

A considerable amount of information is provided. I hope conservation managers will find time to familiarise themselves with projects relevant to their areas of interest and consider how the results may be used to advance management.

Please contact the project leader for further information if necessary and particularly note that detailed reports are available in several cases.

This report is designed to transfer information on activities in this directorate to conservation managers at all levels. I welcome constructive feedback from all who use it.

Richard Sadleir,
Director (Science and Research).

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GUIDE TO SCIENCE AND RESEARCH PROJECT SUMMARIES.

Introduction

This report is a collection of project summaries from Science and Research Directorate which cover all work carried out in the financial year 1987-88.

This section describes how information in this report is arranged.

Project Number.

Each project number is unique to the project.

Eg. S9020/11•

S = Science and Research Project

90= Programme number

20= Subprogramme number

11= accession number.

• = more detailed report is available from your library or Science and Research Directorate.

Accession Number.

This number is assigned in sequential order to projects grouped by agency.

Corporate Objective

This number is the main corporate objective supported by the project. The corporate number system is that adopted by the department in March 1988 and appears in Appendix 1.

Programme/Subprogramme

These are the science programme/subprogramme under which each programme is classified.

Summaries order.

This report is in programme order. Programme 10 to programme 90. Within each programme in subprogramme order and then accession order.

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Index by subject, locality, status and corporate objective are to assist in locating topics.

Status

This gives the status of the project at 1 April 1988. The categories are defined as:

Completed -all objectives met.

Current -for projects approved and commenced in first year or for projects commenced before DOC was established.

Fieldwork completed - when fieldwork is finished but not writing-up
Labwork completed -lab and fieldwork are completed but not writing-up in process

Manuscript(s) in progress -final report(s)/paper/etc is being written or refereed.

Monitoring only -major fieldwork is completed and monitoring only required.

New project -for projects approved and/or started in the financial year 1987/88

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PROGRAMME 10 : INFORMATION.

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- 10 Education, Training
- 15 Planning Systems
- 20 Information Systems
- 25 Databases, Archives, Collections
- 30 Science Advice
- 35 Science Liaison
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TITLE: Application of Conservation Sciences Information in planning processes.

PROJECT LEADER: Mary McEwan

PROJECT: Covers any activity involving provision of scientific information into planning processes -either statutory or management planning.

OBJECTIVES:

To improve the flow of information on New Zealand's natural and historic resources into planning processes, in order to achieve effective conservation.

METHODS:

Information from WERI, Ecological District descriptions, PNA survey reports, Sites of Special Wildlife Interest inventory and other natural and historic resource reports is provided to planners for use in planning schemes or management plans.

INTERIM RESULTS:

Little work has occurred in this project since 1 April 1987, apart from provision of WERI information to certain local authorities etc as well as to DOC regions.

TITLE: Ecological Regions and Districts of New Zealand

PROJECT LEADER: Mary McEwen

PROJECT: Production of 3rd edition maps of ecological regions and districts of New Zealand with brief summary prescriptions of each district printed on the map surface and longer ecological descriptions of the districts in a booklet accompanying each map.

Maintaining the database of ecological district boundaries and descriptions, as overall co-ordinator.

OBJECTIVES:

To compile a national division of New Zealand into areas where the topographical, geological, climatic, soil and biological features, including the broad cultural pattern, produce a characteristic landscape and range of biological communities. The main purpose of this division is as a framework for defining "representative samples of all classes of natural ecosystems and landscapes" (Reserves Act, 1977).

METHODS:

Recommended changes to 2nd edition ecological district boundaries, resulting from PNA surveys and other projects, were checked by the two DSIR co-ordinators, Dr Ian (North Island) and Dr Brian Molloy (South Island), before being incorporated in 3rd edition maps.

Descriptions and prescriptions were compiled from published and unpublished information and checked/edited by the ecologist who proposed each district originally.

RESULTS:

Publication of "Ecological Regions and Districts of New Zealand. Third revised edition in four 1:500,000 maps". Each sheet accompanied by a booklet. Editor, W. Mary McEwen. New Zealand Biological Resources Centre Publication No. 5.

RECOMMENDATIONS:

Continued updating of ecological district boundaries and information in prescriptions/descriptions. Possible handbook(s) of Ecological Districts of New Zealand.

TITLE: Wetlands of Ecological and Representative Important Inventory
(WERI)

PROJECT LEADER: Mary McEwan

PROJECT: Management of WERI; a display describing the inventory has been prepared (3 copies).

OBJECTIVES:

To manage the WERI inventory including editing and adding new information; to establish verification and updating procedures for WERI data and procedures for assessing wetland significance (in consultation with PES).

METHODS:

WERI is currently managed on a Wang PC using dBase3+; information sheets and maps are held in filing cabinets.

INTERIM RESULTS:

Since 1 April 1987, 32 requests for information have been answered, the majority being DOC requests especially for the Coastal Resource Inventory and PNA surveys; also several consultants, Northland Catchment Commission, university requests, Federated Farmers, DSIR. During this time the inventory has been downloaded on to a PC and data-entry errors have been corrected.

INTERIM CONCLUSIONS:

With more publicity use of the inventory should increase.

TITLE: Information -general.

PROJECT LEADER: Malcolm Harrison

OBJECTIVES: To maintain an awareness of both information requirements and the techniques and technical equipment that could contribute to meeting those requirements.

METHODS:

General liaison with DOC staff at all levels and interests and reading current journals.

INTERIM RESULTS:

Software for general use throughout DOC on microcomputers has been recommended and widely accepted. Training in the use of has been started with district and regional staff.

TITLE: Development of an ecological inventory system.

PROJECT LEADER: Malcolm Harrison

PROJECT: The development of an ecological inventory system for DOC.

METHODS:

A description of the information involved and its interrelationships determined by information analysis techniques and described in a data model.

The establishment of DOC wide interim databases (using micro computers) which conform as far as possible with the data model.

To establish a DOC wide acceptable set of keywords and thesaurus of ecological terms.

INTERIM RESULTS:

A general model has been completed but a specific area for improvement has been identified as that dealing with documents.

Interim databases are being set up in regions and regional and district staff have been trained in the principles of the data model and a database application package.

The establishment of a co-ordinating group is in progress.

TITLE: Directory of conservation-related research capability

PROJECT LEADER: Mary McEwan

PROJECT: To establish and maintain a database of agencies and consultants with research skills appropriate to Department of Conservation requirements and to publish this as a directory.

OBJECTIVES:

To provide a directory to agencies/people with conservation-related research skills as a quick reference.

METHODS:

A questionnaire was sent to research agencies by the DOC Establishment Unit (P. Tortell) and refined questionnaires have been sent to further agencies and consultants since. A list of key-words was derived from the results to cover the range of research areas. Data was entered on a Wang PC using Information sheets from the database were then sent back to the agencies etc to be checked. Further information is held in a filing cabinet.

INTERIM RESULTS:

A database with 151 records exists. A report will be prepared (for DOC use) in the form of a Directory.

TITLE: List of Databases and other information sources (CRRC)

PROJECT LEADER: Mary McEwan

PROJECT: To establish and maintain a database of databases and other information sources of value to DOC staff, and to publish this (for DOC) use.

OBJECTIVES:

To provide a quick reference to other sources of information.

METHODS

The main reference was the LINZ Directory of Geographic Data Systems within Central Government (LINZ 1986). Other information was obtained directly from database managers. A database was setup using on a Wang PC, listing Title, Agency, Contact person, Address, Phone, Fields (a short set of key-words describing the general area of the database), Description (briefly describing the database or other information source) and Content (with more details of what it contains).

INTERIM RESULTS:

A database with 63 records exists. More information to be added as it becomes available. A report will be prepared as a list of databases etc. Information from the LINZ directory cannot be re-published because of copyright.

TITLE: Losses of wildlife from habitat since initial identification of sites of special wildlife interest.

PROJECT LEADER: C Ogle

OBJECTIVES:

To provide a model for managers to assess the amount of loss of wildlife habitat in or whole of their regions since sites of special wildlife interest (SSWI) were identified by the Fauna Survey Unit (FSU) of the New Zealand Wildlife Service.

METHODS:

In 1984, Wildlife Service staff at Whangarei did an aerial survey of Northland, checking the area of SSWI against the maps of those sites made during the survey in 1978. Some ground checks were made where boundaries could not be determined from the air, especially in wetlands. The areal extent of each SSWI was compared with its earlier area, and the data were analysed for various types of wildlife habitat (forest, freshwater wetland, estuary) and against various levels of wildlife importance given to those sites originally.

INTERIM RESULTS:

(a) Anderson, Hogarth, Pickard and Ogle (1984) "Loss of wildlife habitat in Northland Tech. Report No. 6. New Zealand Wildlife Service. This report is seen as a model for the survey of other districts or regions, and even the re-survey of Northland now that a further five years have elapsed.

(b) Part of all of Westland was re-surveyed from the air c. 1985 by local Wildlife Service Staff but the results have not been analysed.

(c) A proposed pamphlet/short paper outlining the precise procedure for re-survey and data analysis has yet to be prepared.

INTERIM CONCLUSIONS:

The prototype study from Northland has been extremely widely cited, and has been extremely useful in identifying rates and types of losses of natural areas.

TITLE: The maintenance of the Fauna Survey Units database on sites of special wildlife interest, and possible broadening of its use for DOC purposes, and further analysis of data from FSU surveys.

PROJECT LEADER: Mary McEwan

PROJECT: Management of the national set of maps and data cards of the Sites of Special Wildlife Interest inventory.

OBJECTIVES:

To answer requests for information: to establish means by which SSWI data can be updated; to have relevant SSWI data entered into the DOCNet Database.

METHODS:

SSWI is currently managed as hard-copy maps and data-sheets. Information was obtained from NZ Wildlife Services National Habitat Survey and further information is available in reports of the Fauna Survey Unit.

TITLE: Science Liaison and Advisory Services

PROJECT LEADER: Philip Simpson

OBJECTIVES:

To understand and help satisfy science information needs of conservation planners, managers and decision makers within the department.

METHODS:

To set up and maintain communication networks to and from regions, directorate and external research groups, and develop and implement information transfer programmes.

INTERIM RESULTS:

(a) Regional advisory scientists have been established in Wanganui, West Coast, Canterbury and Southern Regions and soon will be in Nelson/Marlborough. They have quickly become an integral part of the regional team.

(b) Central liaison scientists have been assigned to each region and to each directorate. Communication with regions/directorates has been variable but most liaison scientists have regular contact with their regions by telephone, fax, letters and to a lesser extent by visits. On balance the network has improved the flow of information to and fro.

(c) Scientific advice has been given by directorate staff on request. Requests have been very ad hoc and predominantly reliant on past networks. There is a great potential for expansion of this activity.

INTERIM CONCLUSIONS:

Science liaison and advisory services are an essential aspect of the directorate's work. Initial teething problems only underline the need. More effort is required in refining liaison systems and establishing good networks.

TITLE: Scientific input to Subantarctic island management

PROJECT LEADER: P Dingwall

PROJECT: Scientific planning and advice for management of NZ and other subantarctic islands.

OBJECTIVES:

To make an effective contribution in review, planning and advisory services for managers of subantarctic island nature reserves.

METHODS:

Prepare review papers, guidelines, plans and submissions.

INTERIM RESULTS:

(1) 11-15 May 1987 attended, at invitation of Australian authorities, a scientific symposium on Macquarie Island -convened in Hobart, Tasmania. P. Dingwall chaired the session on Management, History and Archaeology. The NZ approach to reserve management planning has been adopted for Macquarie Island.

(2) Preparation of departmental submission to Director-General IUCN on NZ Sub-Antarctic island conservation (October 1987) -a major review of the conservation status of the islands as part of a global review by IUCN.

(3) August 1987 -paper presented by Dingwall to IUCN/CNPPA Working Session "Directory of Protected Areas on Islands of the Southern Ocean - an update 1987" which is a draft update of a formerly published Directory which comprehensively summarises the state of protection of the 22 major subantarctic island groups in the Southern Ocean. Revised publication anticipated 1989.

TITLE: Publications in science

PROJECT LEADER: Jane Napper

OBJECTIVES:

- a) To establish and manage a series of science publications.
- b) To manage the directorate's editing and report system.
- c) To establish and manage the publicity of the directorate.
- d) To establish and manage the distribution of all science publications received.

METHODS:

To identify the needs and design a system that will meet them.

INTERIM RESULTS:

- a) Three series of science publications has been established. Internal report series is on and the first of the other series are presently being finalised.
- b) A directorate newsletter, Science Faction/Fiction has been established and is issued every 2 months.
- c) A system for distribution of all science publications (internal and transfer funding) is operating efficiently.

INTERIM CONCLUSIONS:

The directorate publication system is established and running. A small amount of the backlog from past agencies has been cleared but due to staff vacancies not as much as expected. A large quantity of internal reports and transfer funding publications have been distributed and the feedback from the regional and districts is very positive and is improving the information flow.

RECOMMENDATIONS:

For the backlog of editing and publishing to be cleared additional staff is needed with scientific editing expertise. Present system is satisfactory but some changes will be needed when it is fully staffed.

TITLE: Contracts and Grants; Administration and Management

PROJECT LEADER: Brian Reid

PROJECT:

To develop, administer and manage research contracts and scholarships awarded to external agencies, institutions and individuals.

OBJECTIVES:

To enhance or supplement inhouse scientific studies or research capability in those fields or spheres of importance to the management of the DOC estate.

METHODS:

Employing external expertise on a contract (scholarship) basis under the safeguard of appropriately drafted and monitored terms.

INTERIM RESULTS:

A generally satisfactory 'year one' of operation with no major hitches and a considerable input of meaningful and relevant information.

INTERIM CONCLUSIONS:

Externally funded research, competitively priced and well executed , is an indispensable component of DOC's technical/scientific expertise.

RECOMMENDATIONS:

That DOC retains its capacity to 'hire' external expertise

TITLE: Science Plan 1988-89

PROJECT LEADER: Philip Simpson

OBJECTIVES:

To direct the scientific resources of the department towards obtaining new information identified by management and to transfer existing information in a useful form to the relevant managers.

METHODS:

New science proposals were received from DOC regions, districts and central office directorates. Subplans were prepared in consultation with each directorate and then amalgamated to form a plan. In consultation with Conservation Sciences Advisory Committee, DOC directorates and regions, money and people will be allocated to science programmes. These will be run by programme managers, guided by the Science Plan and Corporate Objectives.

INTERIM RESULTS:

The process of preparing a Science Plan has increased communication between the Science and Research Directorate and DOC regions and directorates. Management-driven priorities for science activity have been more clearly identified as have gaps in our knowledge and in-house science capability.

INTERIM CONCLUSIONS:

The Science Plan process is very worthwhile in principle but in future years it must be streamlined. Better instructions from Science and Research Directorate are required to improve communication and efficiency.

TITLE: Science Planning Systems

PROJECT LEADER: J.R. Keys

PROJECT: Develop the science planning systems and databases appropriate to the science and research needs of the directorate and department.

OBJECTIVES:

- a) Establish versatile and updatable computer based systems for recording proposals and current projects for department-wide use.
- b) Co-ordinate the completion of Proposal and Current Project registers as hard copy reports.
- c) Refine recording forms, accession systems, classification and numbering systems, data handling systems and reporting systems.

METHODS:

- a) Compilation of proposal and project records
- b) Data entry, editing etc of records on dBase3+.
- c) Review and update of systems with consultation.

INTERIM RESULTS:

- a) Data handling systems and computer data bases established
- b) Compilation of 470 proposals and production of a draft proposal.
- c) Compilation of 350 current science projects.

INTERIM CONCLUSIONS:

- a) Computerisation has produced a versatile, updatable research planning system, elements of which are most flexible when based on data modelling.
- b) Wide consultation is required when developing science planning.
- c) The registers can help fill a demand for information about the department's science needs and capacity.

PROGRAMME 20 : PHYSICAL PROCESSES AND RESOURCES

- 10 Climate, Atmosphere
- 20 Hydrology, Glaciology
- 25 Water Management
- 26 Geothermal Systems
- 30 Oceanography,
- 35 Coastal Processes
- 40 Geology, Geomorphology
- 50 Soils, Pedology
- 55 Soil Conservation
- 60 Natural Hazards, Monitoring, Analysis

TITLE: Glacial extent and snow distribution and their relationships with climatic change on Mt Ruapehu, Tongariro National Park

PROJECT LEADER: J R Keys

PROJECT:

The present day extent of glaciers and their snow cover is being determined for comparison with surveys in the 1960's and to provide a baseline for further changes.

OBJECTIVES:

- a) Determine the present day extent of glaciers.
- b) Measure the amount of change from the 1960's.
- c) Investigate the factors causing this change and make predictions for the future.

METHODS

- a) Relocate past photopoints used by A. Heine in the 1960's and the glaciers and certain snow patches from those points and additional points where necessary.
- b) Measure the elevations of present glacier terminals and late summer snowlines.

INTERIM RESULTS:

- a) Most of A. photopoints can be located but some are no longer useful because of erosion or glacial recession.
- b) All nine of Ruapehu's glaciers were photographed in autumn at times when snow cover was at a minimum.
- c) The present extent of these glaciers and the elevations of their terminals and equilibrium lines have been determined.

INTERIM CONCLUSIONS:

- a) Ruapehu's glaciers presently cover 4 square kilometres.
- b) Most of the glaciers have thinned between 2 and 30 metres and retreated by an average of 240 metres since the 1960's.
- c) One glacier has thickened by up to 30 metres at its snout since 1962.
- d) Present elevations of equilibrium lines suggest that predicted climatic warming will not cause these glaciers to disappear, especially if seasonal snowfalls increase.

PROGRAMME 30 : ECOLOGICAL PROCESSES; BIOTIC RESOURCES

- 05 Mountainlands
- 10 Tussocklands
- 15 Forests
- 20 Shrublands
- 25 Coastal Lands, Sand Dunes
- 30 Islands
- 35 Bogs, Swamps (Freshwater)
- 40 Lakes, Rivers, Streams
- 45 Estuaries, Lagoons
- 50 Coastal, Marine
- 55 Extreme Environments, Special Ecosystems
- 56 Geothermal Systems
- 70 Agricultural Lands
- 75 Urban Lands
- 80 Ecological Modelling
- 85 Biogeographic Survey (e.g. PNA survey, coastal inventory, natural resource assessments)
- 90 Biogeographic Inventory Method
- 95 Ecological Monitoring

TITLE: Biological survey of forested lowlands, Paparoa National Park.

PROJECT LEADER: Geoff Park

OBJECTIVES:

To provide a scientific base for the conservation and management of two significant areas of coastal and lowland forest in central, western New Zealand.

METHODS:

- a) A preliminary inventory and survey of vegetation and landform patterns has been undertaken and reported on.
- b) An intensive study of forest species distribution relationships related to habitat conservation has been undertaken. Several reports and research papers are emerging (R.L. De Velice and G.N. Park).
- c) A liaison is maintained with local DOC personnel.
- d) Detailed research at two specific localities has revealed much information on the landscape history of each area.

INTERIM RESULTS:

- a) The initial research with the National Museum, Wellington, and Ecology Division, DSIR, Nelson, demonstrated the high ecological diversity and the wintering significance of these two forest areas for bird species. This major result for conservation in the late 1970's paved the way for substantial protection of large forest sequences in both districts in the 1978-85 period.
- b) R.C. De Velice's research has demonstrated the pattern of forest diversity in the Western Paparoas and how substantially different it is from an equally diverse forest area in Northland (Maungataniwha).

INTERIM CONCLUSIONS/RECOMMENDATIONS

Because of the national, ecological significance of these two districts and the recent establishment of the Paparoa National Park with its limited base of detailed knowledge on the forest areas it contains, a continued research liaison is needed.

TITLE: Biological conservation of Muriwhenua Incorporation's lands in Spirits Bay - Tom Bowling Bay area.

PROJECT LEADER: C Ogle

OBJECTIVES:

- a) To map areas of predominantly native vegetation on the Muriwhenua Incorporation's lands between Spirits Bay and Tom Bowling Bay, and north of the pine plantations.
- b) To record distribution and status of native plant and animal species, especially threatened species.
- c) To assess impacts of introduced animals and human activities on biological conservation values of the land.
- d) To make recommendations to the landowners, through a report.

METHODS/INTERIM RESULTS

The ground survey was completed by Wildlife Service staff in November 1986, and an interim 11 page report was prepared for the Incorporation and for Department of Lands and Survey. A detailed account was promised when all data had been analysed (invertebrates identified etc). The break up of Wildlife Service meant that this task was not completed. In addition to the interim report (still on micro-computer)' the following tasks have been done:

- a) identification by Dr F Climo of all land snails from 20 litter samples (49 species were found, of which 20 are endemic to the Te Pahi Ecological District; a total of 1556 snails was found in the litter samples);
- b) a draft of the small land snail section of the final report has been written;
- c) a combined plant list has been made of all native and introduced species seen in 24 discrete patches of native vegetation. This list is on dBase III and identifies the presence/absence of each species in each of the 24 patches. The list has the potential to be expanded with species from all other native vegetation patches of the ED, many of which have been surveyed earlier by ourselves, and/or staff of Botany Division or Auckland University.
- d) mayfly nymphs from stream collections have been identified (D Towns). Yet to be achieved (but being worked on by other contributors) are sections of the final report on:

- a) bird and reptile distribution
- b) Placostylus and Paryphanta distributions and statuses
- c) other invertebrates, including those in litter samples
- d) vegetation map
- e) recommendations

INTERIM CONCLUSIONS

in draft report. Te Paki E.D. has extraordinarily high levels of among the vascular flora and immobile invertebrates such as land snails. The Muriwhenua lands contain populations of many of these endemic species or races, and the owners' future management of land not yet planted in pines will be very important to nature conservation in Te Paki E.D. The area also links DOC lands at Spirits Bay and the North Cape area, and has high landscape and historic values, and considerable recreation potential.

TITLE: Vegetation Monitoring for Management

PROJECT LEADER: Susan Timmins

OBJECTIVES:

To monitor changes in vegetation to assist appropriate management of particular reserves viz:

- a) Whewells Bush, a kahikatea stand (11.4 ha) where the water table is being raised in an attempt to improve regeneration of kahikatea.
- b) Sphagnum - wirerush mossland at Eweburn, where succession is occurring after an accidental fire.
- c) Mana Island vegetation, where a revegetation programme is being undertaken.

METHOD:

Permanent plots/transects have been established at each of the sites. Various vegetation parameters are remeasured every (a) 6 months, (b) 12 months, (c) 2-10 years.

INTERIM RESULTS:

- a) Baseline data are still being established. Year to year variation in drought/rainfall is so far greater than artificial alteration of the water table. Events such as cyclone Bola have a major impact on this small reserve. A flush of weed species has followed the removal of grazing animals from the reserve.
- b) Initially there was a dramatic increase in total cover. Some species have resprouted from burnt bases or spread by rhizome, other species have established as new seedlings. The rate of vegetation change has now decreased and it is predicted there will be a very slow change back to the original species composition.
- c) No resurveys have been conducted yet

PROGRAMME 40: CONSERVATION OF NZ FLORA

- 10 Native Plants
- 20 Introduced Plants
- 30 Aquatic Native Plants
- 40 Threatened Plants
- 50 Structure, Genetics, Taxonomy
- 60 Plant Materials, Nurseries
- 70 Revegetation and Rehabilitation

TITLE: Interaction between indigenous vegetation and goats on Arapawa Is, Marlborough Sounds.

PROJECT LEADER: Geoff Park

PROJECT:

Arapawa Island, Marlborough Sounds, is, biologically and historically an important site for conservation. Free from the worst browsing mammals, notably opossum, Arapawa contains the only remaining example of a contiguous forest sequence from sea level to upland in the Cook Strait district. It is a rare example of contiguous coastal and lowland forest in central NZ. It was a very important locality for Maori, and the earliest European trade and settlement. The feral sheep, goat and pig population date from 1820's -1880's.

Recovery of the forest from goat, sheep and pig browsing is considered feasible.

OBJECTIVES:

- a) Establishing the plant ecological evidence for the control of feral goat, pig and sheep populations.
- b) Maintaining an interaction with research on the "wild breed" conservation significance of the goat, sheep and pig populations.
- c) Since 1978 the main objective has been the regular monitoring of a series of large exclosure and control plots to measure the rate of forest recovery when browsing is eliminated; to service (a).
- d) To ascertain the history of the influence of people and feral mammals on the island's coastal forests (not yet active).
- e) To measure the age dynamics of the forests affected by a long history of browsing (to integrate with (d); not yet active).

METHODS:

- a) Regular (at least yearly (March) but often six-monthly) day-long visits to check seedling establishment, growth and survival, and the condition of the exclosure and control. 10% of all exclosures and control plots are measured in detail every 4 years (1978, 1982, 1986, 1990 etc).

- b) During the period from 1978-1988 the populations of goat, sheep and pigs have been severely reduced and the ecologically most significant part of the island has been fenced. The monitoring visits are used to ascertain the general pattern of forest recovery.
- c) Close liaison is maintained with DOC personnel who are involved in feral animal control.

RESULTS:

- a) Initially (1975-76) the research provided the scientific basis for managing the island's forests as a local conservation priority.
- b) Since 1975, numerous research reports and seminar papers have been presented with respect to Objective (a).
- c) As a result monitoring plots were established as a permanent baseline for animal control.
- d) The forests are currently beginning their slow recovery several years after the elimination of the great majority of feral animals and the stabilisation of the floor of the steep slope coastal forests.

INTERIM CONCLUSION/RECOMMENDATIONS:

- a) The recovery of the Arapawa coastal forests is, according to the results from the series of exclosures after 10 years' monitoring, going to be a slow process re-establishing a forest understorey.
- b) Because of this and the impossibility of total elimination of goat, pig and sheep, the monitoring of the exclosures and control plots should continue.
- c) The debate with respect to the alternative conservation significance of Arapawa Island, a rare site for genetically isolated domestic animal breeds, continues. The present research needs to extend, eventually, to ascertain the age and dynamics of the coastal forests in view of the early (1770-1800) probable introduction of browsing animals.

TITLE: Habitats of New Zealand's threatened plants

PROJECT LEADER: C Ogle

OBJECTIVES:

- a) To define the major habitat type of each plant species under threat in New Zealand.
- b) To summarise the current (Given, Sykes, Williams and Wilson) Botany Division list of threatened species against habitat types.
- c) To draw conclusions about which habitat(s).
 - (a) contain the largest numbers of threatened species
 - (b) should be targeted for management.

METHODS/INTERIM RESULTS

Using the 1986 version of the Given *et al.* list of threatened plant species, the following has been done:

- a) prepared a list of habitat types
- b) allocated the plants to the major habitat of each species
- c) analysed the data

This work was prepared originally for a lecture series given to Dr Charles Daugherty's Conservation I course at Victoria University in 1986. The data requires updating and re-working on the basis of the current version of Given *et al.*'s plant list.

Discussions were held with Dr Given (in November 1987), and it was agreed to prepare a first draft of a paper for Dr Given's opinions/input.

INTERIM CONCLUSIONS:

Of 225 native plant species in the 1986 list of Given *et al.*, and placed in the IUCN categories of extinct, endangered, vulnerable, rare and indeterminate, the two habitat types with the most threatened species are cliffs (coastal, river gorges, montane and alpine cliffs) with 53 species and wetlands (freshwater and estuarine) with 54 species. Lowland wetlands with 34 species are the single most important habitat, followed by coastal cliffs (21 species), lowland scrub (19 species) and lowland forest (15 species).

TITLE: The management, restoration and creation of wetland ecotones.

PROJECT LEADER: Philip Simpson

OBJECTIVES:

- a) To restore wetland ecotones (especially river banks) so that an interlinked network of national areas exists throughout New Zealand
- b) To understand the significance of wetland ecotones for conservation, assess condition, and identify broad priorities for conservation action.
- c) To understand the cultural and ecological processes operating in wetland ecotones in order to identify management guidelines.
- d) To integrate existing knowledge on the restoration and creation of wetland ecotones and identify research gaps and needs.

METHODS:

Participation in a UNESCO international programme on wetland ecotones. Prepare review document on New Zealand wetland ecotones. Initiate research and advocacy programmes, and identify and implement restoration pilots.

INTERIM RESULTS:

- a) Preparation of poster paper, in collaboration with DSIR and landscape consultant.
- b) Participation in UNESCO Workshop, Hungary, May 1988. Follow up paper in preparation.
- c) Initial pre-conference seminar held, post conference seminar in preparation in order to build interdirectorate links for the project.

TITLE: Some aspects of seed development and seedling growth of rimu,
Dacrydium cupressinum

PROJECT LEADER: Mary McEwen

PROJECT: Rimu seedling from 5 provenances were used in experiments to examine their responses to growing irradiance, temperature, photoperiod and season. Growth was assessed by growth analysis photosynthesis was measured by gas exchange studies. *Pinus radiata* seedlings were used in one experiment for comparison.

OBJECTIVES:

To determine growth and photosynthesis rates in rimu seedlings grown under different environmental conditions to establish why rimu grows slowly relative to *P. radiata*.

METHODS:

Rimu seedlings were grown in semi-and fully controlled conditions; growth analysis was performed; photosynthesis/respiration was measured using an infra-red gas analyser and an assimilation chamber in an open circuit system.

FINAL RESULTS:

Increasing irradiance up to an optimum value, increased the growth rate of rimu seedlings. Growth-rates and optimum irradiance for growth varied with seedling age. Responses of growth rate to temperature showed similarly complicated results; however low night temperature caused decreased growth rate in rimu as opposed to *P. radiata* in which low night temperature causes increased growth rate due to lowered rates of respiration at night. Maximum measured photosynthesis rates in rimu seedlings were $1.1 \text{ umol m}^{-2}\text{s}^{-1}$ compared with $5.0 \text{ umol m}^{-2}\text{s}^{-1}$ in *P. radiata* etc.

FINAL CONCLUSIONS:

Rates of photosynthesis in rimu seedlings are very low compared with rates in *P. radiata*. Rimu seedlings go brown (with reduced chlorophyll content) in winter and growth rate is reduced. Browning occurs at low night temperatures even when day temperatures are high etc. Rimu seedlings cannot establish where winter temperatures are low etc.

1 paper (irradiance) has been submitted to NZJ Botany.

1 paper (temperature) is being completed.

Papers on photoperiod/seasonal responses and comparison with *P. radiata* to be started.

(All material available in thesis.)

TITLE: Cone and seed phenology in several New Zealand conifer tree species

PROJECT LEADER: Mary McEwan

PROJECT:

A field study lasting 2 seasons took place. Species: rimu (*Dacrydium cupressinum*), kahikatea (*Dacrycarpus dacrydioides*), totara (*Podocarpus totara*), Hall's totara (*P. hallii*), miro (*Prumnopitys ferruginea*), matai (*P. taxifolia*) and tanekaha (*Phyllodadus trichomanoides*).
Study area -near Rotorua.

OBJECTIVES:

To determine timing and sequence of events in development of fruit and cones -to allow planning for seed collection.

METHODS:

Sample trees, tagged branches, collected material for lab study, drawing, photography etc.

FINAL RESULTS:

Rimu, miro and matai seed take 2 seasons to develop; kahikatea, the totaras and tanekaha seed develop in one growing season. Tanekaha, miro and matai may be partially monoecious; the other species are typically dioecious. All have wind pollinated ovules and bird (and wind) dispersed seed. Details of timing recorded.

FINAL CONCLUSIONS:

Seed collection can be anticipated well in advance in rimu and miro. Matai ripe fruit hard to find.

Results may be used in studies of frugivorous birds eg kakapo and kokako.

Paper on rimu published (Forest & Bird); on other species, soon to be submitted to Tuatara.

PROGRAMME 50 : CONSERVATION OF NZ FAUNA

- 05 Land Mammals
- 10 Marine Mammals
- 20 Land Birds (excluding gamebirds)
- 30 Seabirds
- 40 Reptiles, Amphibians
- 50 Fish, Freshwater (excluding introduced fish)
- 55 Fish, Marine
- 60 Invertebrates, Terrestrial
- 65 Invertebrates, Aquatic
- 70 Invertebrates, Marine
- 80 Structure, Genetics, Taxonomy
- 90 Habitat Management
- 95 Ecological Monitoring

TITLE: Hooker's sea lion

PROJECT LEADER: M.W. Cawthorn

OBJECTIVES:

- a) To assess the size and status of the Hooker's sea lion population.
- b) To investigate the biology, physiology and behaviour.
- c) To monitor levels of interaction between sea lions and commercial fisheries and the effect of incidental catches of sea lions on the continued viability of the population.

METHODS:

Population censusing at rookeries augmented by aerial photography to provide verification of ground counts. Tagging of pups at rookeries to quantify pup mortality in the first months of life and to assess levels of interchange between natal rookeries.

Sampling at rookeries and the use of instrumentation and radio telemetry applied to adult females.

Behaviour at sea is monitored by MAF fishing observers using standardised recording methods. Animals taken incidentally to fishing are snap frozen and returned to New Zealand for necropsy.

INTERIM RESULTS:

- a) A total of 1966 pups have been tagged at all rookeries.
- b) Results indicate total site specificity to natal rookeries with little or no interchange by mature females. Tag data have also revealed immature animals will roam as far north as Banks Peninsula and at least 11 miles inland via drainage systems and rivers.
- c) 12 sea lions were taken incidentally to fishing operations.
- d) Recent analysis of dive data indicates that Hooker's sea lions spend the greater part of time at sea submerged.

INTERIM CONCLUSIONS:

Incidental catches continue to adversely affect population recovery. Breeding success and rookery site specificity must be closely monitored. Feeding behaviour and fishery interactions studies should be extended.

RECOMMENDATIONS:

Research continues with emphasis on population assessment, feeding behaviour, and fishery interactions.

TITLE: Whale Sightings Survey

PROJECT LEADER: M.W. Cawthorn

OBJECTIVES:

To monitor the seasonal distribution and relative abundance of all whale species on the South West Pacific, Tasman Sea and New Zealand region.

METHODS:

Standardised sightings data are collected from vessels of the RNZN, merchant shipping and fishing fleets, research ships and other vessels. Also contributing are RNZAF and commercial airlines. These observations are augmented by shore-based sightings from offshore island meteorological stations and selected observers in key locations. All strandings and other incidents involving cetacea are recorded.

INTERIM RESULTS:

- a) Sightings of 15,762 cetaceans were recorded at sea between Jan 1986 and March 1988.

Large whales >10m (including minke)	9.6%
Medium whales 4-10m	8.7%
Small whales <4m	81.7%
- b) Large whale sightings indicate a rising trend in sperm whale abundance.
- c) 450 right whales were observed around NZ and the subantarctic islands between Jan 1986 and 1987. Two breeding groups are now known to be present in the subantarctic during winter.
- d) Blue whales are now recorded in NZ waters annually. Largest pod = 7 whales. Greatest individual length = 26m.
- e) 85 strandings involving 1132 cetaceans of 18 species were reported from NZ, Stewart Island and Islands. Eleven massed strandings occurred. 96% of the 1039 whales involved were pilot whales.

INTERIM CONCLUSIONS:

- a) There is a rising trend in numbers of previously exploited or endangered whales species observed in the New Zealand sightings area.
- b) The observational part of the programme is efficient, totally voluntary and cost effective recording more animals of more species than any similar programme elsewhere.
- c) Data are gathered by experienced observers over fixed transects and contributed to a long term series.

RECOMMENDATION:

This programme continues.

TITLE: Kakapo research on Little Barrier, Stewart and Codfish Islands to promote the conservation of the species

PROJECT LEADER: R.G. Powlesland

PROJECT: The mortality and breeding behaviour of kakapo (*Striaops habroptilus*) on Stewart Island were investigated. In addition, the accuracy of the remote radio-tracking equipment was determined and a quantitative assessment was made of the vegetation types in the study area. Field work was completed in 1988. The booming behaviour of male kakapo transferred to Little Barrier Island in 1982 and to Codfish Island in 1987-88 was monitored. On Codfish Island the phenology of some kakapo foods plants was assessed.

OBJECTIVES:

- a) To provide information about several aspects of the Stewart Island population's biology, especially information that might be helpful in making decisions for the conservation of the species.
- b) To determine whether the kakapo breed successfully on Little Barrier and Codfish Islands.

METHODS:

- a) Stewart Island - The population's mortality and breeding behaviour were monitored using radio-telemetry. The accuracy of the remote radio tracking equipment in determining the position of radio-tagged kakapo was investigated using test transmitters and by surveying the positions of the test-transmitters' sites. The quantitative assessment of the species diversity and abundance in each of 10 vegetation types was determined using a point-height intercept technique.
- b) Little Barrier Island - The extent of kakapo use of track-and-bowl systems in January-April 1988 was determined from sign at the systems.
- c) Codfish Island - In January 1988 the phenology of 132 tagged plants was noted and kakapo calls were listened for at night from prominent landforms.

INTERIM RESULTS:

- a) Stewart Island -The vegetation data have not been analysed yet. The positions of the test transmitters were most accurately determined using the remote radio-tracking equipment when experienced people were operating it, and when the transmitter was in line-of-sight with the tracking stations and moving.

- b) It has yet to be assessed how much of the movement data of radio-tagged kakapo will be sufficiently accurate to determine the positions and sizes of kakapo home ranges, and kakapo seasonal movements in relation to vegetation type and breeding status. No dead kakapo were found, and 16 (5 females and 11 males) were transferred to Codfish Island.
- c) Little Barrier Island -Six to eight males were simultaneously active at systems each month during January-April 1988.
- d) Codfish Island - Rimu produced a good crop of pollen cones in December 1987. No kakapo calls were heard.

INTERIM CONCLUSIONS:

It is likely that the rimu will fruit on Stewart Island in autumn 1989, in which case the kakapo are likely to breed.

Although feathers were found at and near the systems on Little Barrier Island, the evidence is inconclusive as to whether mating took place.

Should the rimu on Codfish Island produce fruit in autumn 1989 then in normal circumstances breeding of the kakapo could be expected, but because the birds will have been on the island for only 12-18 months, breeding may not result.

RECOMMENDATIONS:

If the males on Stewart Island are booming intensively in January 1989 then breeding is very likely to occur. In this case both males and females should not be radio-tagged for transfer until March, by which time all mating will have occurred and the females should have laid eggs.

Unless other evidence is found to suggest that the Little Barrier Island kakapo bred in 1988, a search for unbanded birds is not warranted in the next six months. The monitoring of activity at systems should continue for the next six years, unless breeding is evident before then.

Each year during January-March the phenology of fruiting trees and shrubs and the booming of male kakapo on Codfish Island should be monitored until kakapo breeding occurs.

TITLE: The breeding biology, population dynamics, diet, habitat requirements and movement of takahe in the Murchison Mountains, Fiordland National Park.

PROJECT LEADER: J.A. Mills

PROJECT: These studies, initiated in May 1972, have been undertaken in three areas within the Murchison Mountains-Takahe Valley, Miller Peak and Eyles-Wisely.

OBJECTIVES:

- a) To establish the reasons for the decline of takahe.
- b) To obtain fundamental information about recruitment from reproduction and immigration, and losses from mortality and emigration in different parts of the range.
- c) To describe the diet and habitat requirements of takahe and to establish whether deer compete with takahe for the available resources.

METHODS

The breeding biology of individual takahe was followed intensively from 1972 to 1976 and since then on a less intensive basis. The movement, territory size and dispersal of were investigated over a 2 year period using radiotelemetry. The diet was investigated using field observations of food eaten and by recording feeding sign. The competitive interaction between takahe and red deer was studied from samples collected from red deer, and forage availability was measured from random plot samples. Biomass studies were also undertaken to assess the impact of simulated takahe and deer grazing on midribbed snow tussock (*Chionochloa pallens*).

INTERIM RESULTS:

- a) The breeding biology and population dynamics study carried out between 1972 and 1976 showed that approximately 80% of birds breed annually and hatching success was about 70%. Generally chick survival was extremely low with about 74% of the chicks hatching dying within 3 months. The population continued to decline until 1980 when only 114 birds were left. Since then the population has recovered and by 1986 there were 180 present.

- b) The cause of the decline has been found to be competition with introduced deer for food. Experimental manipulation of tussocks to simulate deer grazing has shown that tussocks cannot tolerate being grazed in the manner that deer use. Eight years after tussocks were cut to simulate deer grazing, the biomass of these plants was 64% less than uncut tussocks. It is estimated that it would take 20 years for tussocks to recover from deer grazing. The long lag between the reduction of deer numbers and the recovery of the population results from the long length of time tussocks required to recover.
- c) The deer diet studies have shown that tussocks and grasses make up approximately 23% of the food ingested. Other important items include *Griselinia littoralis* (5%), *Hoheria glabrata* (5%), *Aciphylla takahe* (7%), *Anisotome haastii* (3%), *Celmisia verbascifolia* (3%) and *Ranunculus lyalli* (2%).
- d) Takahe were found to be extremely selective feeders choosing individual plants and parts of the plant that contain the highest nutrient content.
- e) Radiotelemetry studies revealed that preferred to remain in the alpine grasslands for as long as possible. When snow conditions prevented feeding in the grasslands the bird moved into the adjacent beech forest. In some areas were able to remain in the alpine grasslands even in the presence of heavy snow conditions. Those which were able to remain were judged to be in better habitat and correspondingly had higher breeding success during summer.

INTERIM CONCLUSIONS:

For to survive in Fiordland intensive deer control has to be maintained. Any reduction in deer control will result in increased pressure on sensitive plant species critical for takahe survival.

RECOMMENDATIONS:

The results of the research programme have been translated into management proposals. These proposals recommended three procedures -

- a) That management efforts be directed to maintaining the viability of the wild population. This involved (a) maintaining deer control, (b) manipulating clutches to ensure that as many as possible are incubating fertile eggs, (c) removing one egg per clutch from up to 15 pairs for artificial rearing at a captive rearing facility near Te Anau (Burwood Bush), (d) extending the range of takahe into other parts of Fiordland where extensive habitat exists (Glaisnock-Edith area of Stuart Mountains).
- b) Establish a captive rearing facility at Burwood Bush to rear stock for release back into the wild and for the establishment of alternative populations on predator-free islands (Maud Island).
- c) Establish population on pasture grass on a predator-free island (Maud Island).

TITLE: Population dynamics, behaviour, habitat use and diet of the Little Spotted Kiwi on Kapiti Island.

PROJECT LEADER: Jim Jolly

OBJECTIVES:

- a) To describe the breeding biology, social organisation and habitat use of the little spotted kiwi.
- b) To assess the population size and population dynamics of the little spotted kiwi on Kapiti Island.
- c) To analyse the diet of the little spotted kiwi particularly in relation to seasonal availability of foods.

METHODS:

Breeding biology, social organisation, habitat use and population dynamics were investigated by a combination of radiotelemetry, nest surveillance and chick searches.

Population size was estimated from a survey of the distribution and rate of calling of the whole population.

Diet was investigated by faecal analysis, and the availability of the invertebrate component of the diet was assessed by seasonal soil and litter samples.

INTERIM RESULTS:

- a) The birds under study nested in spring. Incubation period was about 70 days and only the males incubated or brooded the young chicks.
- b) Parents keep only a loose escort of the chicks away from the nest.
- c) Only 3 of 28 nests monitored produced young. At least 60% of nest losses were due to predation on eggs by wekas.
- d) Preliminary analysis of call counts indicated a breeding population in excess of 500 pairs.
- e) Pairs occupy territories of 1-2 hectares in both forest and scrub.
- f) In 86 faecal samples, worms, spiders and larval insects were eaten most often. About 30% of the samples contained fruit of trees or shrubs.

INTERIM CONCLUSIONS:

There is a large, widely dispersed population of little spotted kiwis on Kapiti Island, but there are high losses of eggs. Most of these losses are due to predation by wekas. It has yet to be determined whether recruitment to the adult population is adequate.

Analysis of diet and habitat use has enabled an assessment to be made of the suitability of several offshore islands as liberation sites for little spotted kiwis.

TITLE: Kiwi Call Scheme

PROJECT LEADER: Rogan Colbourne

PROJECT: A data base of standardised survey results, documenting the status of kiwi (Apteryx populations, is being collected throughout New Zealand. The project was started in 1986 by the Wildlife Service and transferred to DOC. Collection of data is ongoing.

OBJECTIVES:

- a) To determine the present distribution of kiwis
- b) To relate kiwi density to location and habitat.
- c) To assign a kiwi call index at known time periods of a year at a listening station enabling the dynamics of that population to be determined with time.

METHODS

Rip and waterproof cards, instruction sheets and a tape of kiwi calls have been distributed to each DOC region, relevant DOC districts and to interested organisations or individuals to use when spending nights in kiwi habitat. Each kiwi call heard is recorded along with relevant parameters. Results are stored in a computer for later analyses.

INTERIM RESULTS:

- a) To date about 700 cards have been returned.
- b) The highest densities of kiwi occur in Central Fiordland, Stewart Island, subalpine NW Nelson and northern Northland.
- c) Kiwis occur at relatively lower densities in Taranaki-Waikato, Coromandel-Rotorua-Hawkes Bay, and Arthur's Pass National Park.
- d) Reports of the endangered little spotted kiwi have resulted from surveys in Fiordland, South and Marlborough. As a result a male little spotted kiwi was caught and transferred to safety from d'Urville Island in 1987.

INTERIM CONCLUSIONS:

- a) Many areas where kiwis were recorded from early this century do not have kiwis now.
- b) Most populations of kiwis occur at relatively low densities.

RECOMMENDATIONS :

- a) Northland, particularly Waipoua Forest, with dense kiwi populations are at risk from traps and poisons now that possums have established themselves in those areas, and from the effect of increasing urbanisation in the North, viz fires and dogs. Emphasis on monitoring these populations should be given.
- b) Two of the three brown kiwi populations in the South Island (Okarito and Arawata-Jackson's Bay) be surveyed in detail.

TITLE: Foods, foraging behaviour, habitat use and time budgets of Kokako in Puketi State Forest, Northland.

PROJECT LEADER: R.G. Powlesland

PROJECT: The foods, foraging behaviour, habitat use and time-budgets of kokako (*Callaeas cinerea*) in Puketi State Forest were investigated during October 1981 to August 1982. Field work was completed in 1982.

OBJECTIVE:

To have accepted for publication a paper about the foods, foraging behaviour and habitat use of kokako in Puketi State Forest.

METHODS:

Revision of the paper was carried out with regard to comments from a referee and editor.

INTERIM RESULTS:

The paper has been accepted and published;

R.G. Powlesland 1987. The foods, foraging behaviour and habitat use of North Island kokako in Puketi State Forest, Northland. *New Zealand Journal of Ecology* 10: 117-128.

INTERIM CONCLUSIONS:

The status of the North Island kokako is "vulnerable", and in Puketi State Forest much kokako food was obtained from shrub hardwoods (54%) and tree hardwoods (30%). Considering these facts, logging in the forest should not be allowed. This is because logging is likely to greatly reduce the food available to kokako in whose territories logging is carried out by the removal of important food trees, particularly if podocarps are logged, and because of the destruction of shrub-hardwood trees in order to gain access to trees.

Because the diets of possums and kokako overlap considerably, and the decline of kokako in the North Island is considered to have been caused, in part, by habitat degradation resulting from possum browsing, control operations should be carried out to maintain the possum population in Puketi State Forest at a density that has little impact on the diversity and abundance of kokako foods.

During the study sign of possums increased greatly. This was of concern as possums eat many of the foods taken by kokako. By the end of 1984, possum damage on some kokako foods (e.g. fivefinger) was starting to become pronounced.

TITLE: Habitat study of North Island Kokako, Puketi Forest, Northland.

PROJECT LEADER: Hugh Best

PROJECT: This study was undertaken as a cooperative affair by the (then) New Zealand Wildlife Service (Department of Internal Affairs) and Auckland Conservancy, New Zealand Forest Service.

OBJECTIVES:

The prime objective was to relate kokako habitat use to habitat types, and to define the most important plant species used for various kokako activities, especially the significance of kauri to kokako. In addition an assessment was made of the likely impact of logging and browsing mammals on kokako.

METHODS:

Kokako habitat use was determined from studies in five territories. These territories were marked into 40 m grids which provided

- (i) a means of identifying the parts that were used in each season, and
- (ii) standard sized plots for recording the vegetation structure and composition.

The grid network also provided a series of common units by which the bird use and vegetation data could be analysed jointly.

INTERIM RESULTS:

The relationship between kokako and their habitat was complex and intimate. The way in which kokako used their habitat varied from one activity to another. They lived mainly in the canopy and emergent strata of the forest. Kauri, tree hardwoods and podocarps were the principle groups of trees used for singing. Most feeding occurred in shrub hardwoods, tree hardwoods, and to a lesser degree in podocarps. The main factor determining how, when, and which parts of the habitat were used was the availability of food, which changes with season.

INTERIM CONCLUSIONS:

Kokako favoured areas of undisturbed mature forest. The birds' territories were characterised by containing a mosaic of vegetation types of differing structure and composition. These types ranged from tall trees of large stature (kauri, podocarps, tree hardwoods) through to zones of shorter, more squat trees (shrub hardwoods) growing in damper sites or on former slips or treefalls. Though the fringes of regenerating areas that had been damaged extensively by former logging or hurricanes were used by kokako, none of the study birds ranged far into these areas. Instead they centred their activities largely on habitat containing a fair proportion of tall, mature, undisturbed forest.

INTERIM CONCLUSIONS:

Most forest birds preferred and used large diameter canopy trees at a greater frequency than expected. Removal of a portion of these trees by logging would have an adverse effect on birds by removing a disproportionate large portion of their preferred food trees. Even low impact logging, such as by helicopter and chainsaw mill, could have serious consequences for threatened species, i.e. kaka and kakariki. Rimu, one of the most frequently milled tree species provided very important seasonal food supplies for several bird species. Papers outlining the major results of tree species use, and foods and foraging behaviour are in the final stages of preparation. A paper outlining the model for predicting the impacts of logging on forest birds is also near completion.

TITLE: Distribution, abundance and population trends of yellowheads

PROJECT LEADER: C. O'Donnell

PROJECT: The yellowhead is an endemic forest bird formerly found throughout the South Island. They have now disappeared from 75% of their former range and their distribution appears to have steadily contracted over the last 10-15 years. Yellowheads are in danger of becoming extinct if these trends continue. All South Island Regions can contribute to the conservation of this species.

OBJECTIVES:

- a) To document the pattern of change in yellowhead populations at a network of sites through the South Island.
- b) To determine the current distribution and abundance of yellowheads in the South Island.
- c) To monitor annually the yellowhead population in the Hawdon Valley, Arthur's Pass National Park, and to determine trends in this population.

METHODS:

Surveys are undertaken in late December birds are vocal and conspicuous. Established transects are surveyed and numbers and locations of yellowheads recorded.

INTERIM RESULTS:

- a) Yellowheads have now almost disappeared from Nelson, Marlborough, Canterbury and North and Central Westland. They are rare in South Westland. Arthur's Pass supports the only major population outside Fiordland.
- b) The numbers of yellowheads recorded in the Hawdon Valley had remained fairly constant between 1983 and 1986 (31, 35, 40 and 34 birds). However in November 1987 only 14 birds were recorded representing a 65% reduction. The upper valley, outside the study area, was also surveyed but no further birds were found. Up to 20 individuals had been found previously. During 1986 there had been an eruption of mice and stoats in the Hawdon Valley.

INTERIM CONCLUSIONS:

- a) The yellowhead population at Arthur's Pass is spread through several valleys but everywhere numbers are low compared with densities found in parts of Fiordland. Arthur's Pass appears to be an area where a significant population decline is ongoing.
- b) The drastic decline in yellowhead numbers in the Hawdon Valley is cause for considerable concern. We suspect that this is the result of the eruption of mouse and stoat populations in 1986 leading to increased stoat predation. This is substantiated by similar events in the Valley, Fiordland, in November 1987. G. Elliott (Victoria University) found that 50% of female yellowheads in his study were predated on their nests by stoats. Vulnerability to stoat predation could explain the steady decline of yellowhead.

TITLE: Forest bird studies in South Westland

PROJECT LEADER: Colin O'Donnell

PROJECT: In 1981 the Ministers of Forest and Environment announced a moratorium on timber production in State Forests south of the Cook River until 1990. The investigation areas covered 600,000 ha of Crown Land. Research was carried out to enable decisions on future land use and land classification.

OBJECTIVES:

- a) To develop methods for bird distribution mapping and collection of habitat-use data.
- b) To quantify distribution of forest birds in South Westland.
- c) To quantify habitat-use by forest birds in representative forest types of South Westland.
- d) To develop a model for predicting the impacts of logging, on forest birds.

METHODS:

Field methods were developed for mapping distribution and recording habitat-use by forest birds. Distribution was mapped in 15 areas using grid square mapping. 147,000 ha were surveyed. Habitat-use observations were made in the Windbag Valley in forest types representative of South Westland. The area was visited every two months for three years and habitat characteristics such as tree species and size, food, stratum and perch were quantified. 62,757 instantaneous observations were collected between 1983 and 1985.

INTERIM RESULTS:

Bird mapping provided detailed data essential for making balanced decisions on land use and allocation. A paper outlining this method, suitable for use by forest managers is being published as a DOC report. Habitat-use data was gathered for 26 bird species. Seasonal use of canopy and understorey plants was quantified. Frequency of use of plant species was compared with availability to determine preferences for each bird species. Foraging behaviour was studied and related to flower and fruit availability and to seasonal patterns. A model has been developed to predict the impacts of logging on forest bird species. The proportions of highly preferred trees removed by different extraction rates was quantified.

TITLE: Population dynamics of Blue Duck on the Manganui-a-te-ao River.

PROJECT LEADER: Murray Williams

PROJECT: The biology and population dynamics of blue ducks inhabiting the Manganui-a-te-ao River in central North Island have been studied since 1980 to provide knowledge upon which a national conservation strategy for the species can be based.

OBJECTIVES:

- a) To study long-term changes in the population by measuring the number of young produced annually, the survival and dispersal of juveniles, longevity of adults and changes in the density of the population.
- b) To determine what factors influence breeding density by measuring (a) territory size and the seasonal variation in the use of those territories; (b) relating the pattern of territory use to the distribution and abundance of food within the river.
- c) To determine what proportion of each year's production of juveniles may be removed (to establish populations elsewhere) without having a long-term effect on the population.

METHODS:

By direct observation of banded and unbanded birds on an 8 km section of the river and periodic surveys of the entire river. Freshwater invertebrates are sampled using surber samplers.

INTERIM RESULTS :

- a) 1987/88 was a poor breeding year with only 5 young fledging from the 8 study pairs.
- b) Poor breeding occurred elsewhere on the river.
- c) Three of the eight pairs comprised sibling pairings and there was less direct relatedness between members of most other pairs.
- d) Birds bred in the study area continue to attempt to settle in or close to their natal range.

INTERIM COMCLUSIONS:

- a) Blue duck appear to be erratic breeders: in four of the past 8 years, annual productivity has been 1 chick per pair or fewer.
- b) Good and bad breeding years have alternated regularly over an 8-year period.
- c) It is only after very highly productive years that increases in population density have occurred -not after average or below average years. The very good years appear to have to compensate for previous bad years.
- d) There is an astonishingly high degree of relatedness appearing amongst study birds. This has major conservation implications and requires more detailed investigation to determine whether it is natural in all blue duck populations or an artifact of population isolation.
- e) Individual pairs differ greatly in their breeding success implying all are not worthy of the same conservation effort.

TITLE: Radio transmitter packaging and harnessing techniques for animals.

PROJECT LEADER: M. Douglas.

OBJECTIVES:

- a) To redesign the radio transmitter package currently used, to improve assembly speed, and to enable possible future user assembly.
- b) To design and test a reliable transmitter package harness release system that will respond to battery and transmitter failure.

METHODS:

- a) Manufacturers to be approached for quotes on the manufacture of suitable transmitter cases. Test and evaluate in field.
- b) Laboratory design of an electrical harness release system, evaluate in field.

INTERIM RESULTS:

- a) Packaging: Recent changes in availability of battery shapes and sizes require several types of packages. After battery testing has been completed the packaging designs can be finalised.
- b) Harness release: Circuit design tested. Problems encountered are: size of additional componentry, release mechanism reliability, and complexity of the system.

INTERIM CONCLUSIONS:

Conventional degrading harness links are available but have indeterminate times for release. Some may stay on too long, others come off too early. A more reliable technique for releasing the package (if the transmitter fails or the battery goes flat) has been partly designed. The technical limits of components will govern ultimate reduction in size, and thus the smallest animal it can be used on. There is always a trade-off of transmitter size and weight, to transmitter life and power.

TITLE: Designing a radio transmitter inventory and testing programme for radio telemetry studies.

PROJECT LEADER: M. Douglas.

OBJECTIVES:

- a) To enable more accurately to predict transmitter reliability and to calculate a safe field life.
- b) To build a data-base of records for ease of access to technical information on each transmitter and to enable comparison of design with performance.

METHODS:

- a) A number of laboratory techniques are required to test individual radio transmitter current consumption, RF power, tuning and spurious behaviour. Analysis of any recovered failed transmitters to determine why they have failed.
- b) A dBase3 data-base input program to be designed by programmer. Data gathered already on card indexes to be recorded onto data-base. Analysis to be done on data already gathered.

INTERIM RESULTS:

- a) Individual transmitter current consumption data is already recorded before each use. Better instruments and more refined techniques are being used to gather data. Transmitters are run in the laboratory for several days prior to use to locate any early failure of components. An automatic test monitor for this operation is needed to enable intermitent behaviour to be detected.
- b) The data-base has not been finally completed by the programmer. Records are currently held on card file.

INTERIM CONCLUSIONS:

Analysis of failed transmitters from Little Barrier showed incorrect life expectancies of the units were calculated by the manufacturer. This type of failure can now be eliminated by laboratory testing. Other tests will help to remove poor or defective transmitters before use in field.

TITLE: Improvement of land tracking antenna for bush radio tracking.

PROJECT LEADER: M. Douglas.

OBJECTIVES

- a) To reduce the size of conventional hand antennas for use in thick bush.
- b) To improve efficiency of the hand antenna.
- c) To provide working plans for users to manufacture their own.

METHODS:

Laboratory design of array. Reduction of element length and improve folding mechanism for storage and transport. Field test against conventional antennas, measure efficiency, report results.

INTERIM RESULTS:

Reduction of element length has been achieved but tests required to evaluate any possible loss in efficiency. Two array designs are at drawing stage only.

INTERIM CONCLUSIONS:

A reduction in element length can be achieved, but work is still at an early stage of development.

TITLE: Population Ecology and taxonomy of Albatrosses in NZ

PROJECT LEADER: C J R Robertson

OBJECTIVES:

To locate, survey and assess the population sizes of all NZ albatross populations and undertake long term monitoring of numbers.

To gather similar ecological and breeding data on all species.

To gather daily ecological data at Taiaroa Head, experiment with management techniques such as fostering and hand rearing for eggs and chicks, assess the effects of predation and human disturbance and provide management advice as required.

Using museum and field data to review and where necessary revise the taxonomic status of all species.

METHODS:

Visits to the isolated breeding localities of these species are irregular and all standard field techniques, air photography, morphometric, breeding and plumage studies are used according to circumstances. Since 1972 most populations have been visited at least once for a minimum of two days at critical parts of the breeding cycle. At Taiaroa Head the daily observations (1968 -1988) plus data back to 1937 provide an important base line for comparison with all other studies worldwide. Museum material is reviewed as necessary to provide morphometric and plumage comparisons.

RESULTS:

- a) Taiaroa Head observations continued. The death of three chicks following a period of excessive head unfortunately included a chick which had been successfully fostered from hatching without the presence of its own parents or other spare foster parents. Periods with other parents plus a supplemented artificial diet produced a satisfactory growth rate.
- b) An analysis of over 800 predators trapped at Taiaroa Head in years 1959 + 1968-1986 showed a strong relationships between rabbit numbers and influxes of predators dangerous to the birds (ferrets (21%), stoats (13%) and cats (8%) of total catch). Critical months for cats -Oct-Jun. Critical months for ferrets -Feb-Sept.
- c) Museum collections of Wandering Albatross skins, skeletons and eggs were studied in Vienna, Copenhagen, Stockholm, Oslo, New York, Chicago, Denver, San Francisco and San Diego and Los Angeles completing data collection from over 34 museums worldwide undertaken between 1975 and 1988.

These data, combined with field data suggest that the Wandering/Snowy/Amsterdam Albatross groups should be established as 5 full species with two new species to be described. Both new species breed only in the New Zealand area at the Antipodes/Campbell Islands and at the Auckland Islands and show no evidence of travelling outside the Pacific and Australasian area. It is expected that papers establishing these new forms will be completed in 1988.

TITLE: Population Ecology of the Australasian Gannet in NZ.

PROJECT LEADER: C J R Robertson

OBJECTIVES:

- a) To establish the population dynamics of a gannet colony, using known age birds, colony growth patterns, annual air and ground censuses at Cape Kidnappers.
- b) To study productivity according to age and breeding status and the effects of immigration and human disturbance.
- c) To assess changes in the national population at regular intervals.

METHODS:

Annual ground counts of specific Cape Kidnappers colonies are made in the 3rd week of December each year with samples of chick ages to indicate the timing of the breeding season (data set available 1945 - 1987). Annual sets of air photographs for all Kidnappers colonies are taken for later counting (1965 -1987 available). Approximately every ten years a full air census of all NZ colonies is undertaken and broad trends established. Regular monthly breeding season counts (ground and air) for at least one and preferably two widely separated colonies are required as indicators of season timing in year of full national census. A known age population of birds (banded 1950 -1970) at Cape Kidnappers provides data on mortality and productivity.

RESULTS:

- a) The annual counts and air surveys were undertaken at Cape Kidnappers.
- b) Following public concern at the death of chicks on the colony at Cape Kidnappers in March 1987 and the suggested decline in numbers there an analysis was made of local and national trends.
- c) National populations are increasing at a mean rate of 2.3% per annum based on three censuses (1947, 1969, 1980).
- d) There are different rates of growth in various of the Cape Kidnappers colonies which are related to the filling of available nesting areas, overflow and immigration into new areas, and the changing age structure and therefore productivity of some colonies.

- e) Annual populations fluctuate according to natural events, including late nesting, mortality caused by severe weather at hatching and after fledging, food supply impairment or failure. Since 1945 these have occurred in cycles and a combination of events may cause abnormal mortality and affect breeding numbers for as much as seven years.

- f) The diet of Kidnappers gannets in March contains a high proportion of pelagic fish. A failure in this food supply in March 1987 was probably related to the El Nino phenomena which affected similar food supplies for tuna and marlin at the same time. It is likely that inshore food supplies were similarly affected in the season

TITLE: Population dynamics and breeding biology of the known-aged population of red-billed Gulls, Kaikoura Peninsula

PROJECT LEADER: J.A. Mills

OBJECTIVES:

The study was initiated in 1964 and the aim of this long-term study has been to examine factors which regulate population size and structure. The population at Kaikoura has been banded annually since 1958 and because many individuals are of known age and known parentage, it provides a unique opportunity of studying factors which control populations. The factors being studied include:

- a) The role inheritance plays in aspects of the breeding biology.
- b) To investigate lifetime reproductive rates of individual birds. Lifetime reproductive rates provide the best measures of fitness. "Biological fitness" is of great theoretical importance for species management.
- c) To determine the age of first breeding, the effect of age on breeding success and the proportion of the population which breeds.
- d) To examine factors which affect survivorship of adults.

METHODS:

Banding of nestling red-billed gulls at Kaikoura has been undertaken annually for 30 years (1958-1987) and more than 90,000 have been marked. Study birds have been colour-marked for identification and up until 1986, 3304 adults have been given individual colour combinations; an additional 859 marked with a single colour, and 245 had received a large darvic band engraved with alphabetic and numerical characters. As well, since 1979, 1078 chicks have been marked with a single colour band. Each season the fate of nests of colour-marked gulls is determined.

INTERIM RESULTS:

- a) An interim analysis has shown that breeding success is not inherited. As well factors such as laying date and frequency of breeding, which are important factors determining how successful a bird will be as a breeder, are also not strongly inherited traits.

b) Lifetime breeding success rates of individuals has shown that there is considerable variation between individuals in the total number of young they fledge. Among those which bred, 20% of the males in the population produced 58% of the fledged young and 15% of females produced 52% of the fledged young. Only 17% of males and 24% of females recruited young into the breeding population during their reproductive lifetime.

INTERIM CONCLUSIONS:

The results of the lifetime analysis has important implications in the conservation of bird populations. Only two studies detailing lifetime reproductive rates have been published to date. The red-billed gull study together with those of Newton (1985) *J. Anim. Ecol.* 54,241-253 and Hotker (1988) *J. Anim. Ecol.* 57, 109-117 show consistent findings which emphasise that relatively few individuals maintain the population from one generation to the next. If populations are to eggs taken from individuals, it is imperative that the most productive individuals are not interfered with because it is these individuals that maintain the population.

TITLE: Ecology and conservation of Chatham Island Taiko

PROJECT LEADER: M.J. Imber

PROJECT: The Chatham Island Taiko, or Magenta Petrel *Pterodroma magentae*, is an endangered seabird now reduced to less than 100 individuals. The search for its breeding places has been in progress since it was rediscovered in 1973. In 1982 the New Zealand Wildlife Service initiated trials on transmitters suitable for use on Taikos. The Department of Conservation has collaborated with the Taiko Expedition, led by D.E. Crockett and largely sponsored by the Ornithological Society of New Zealand, in continuing this project.

OBJECTIVES:

- a) To find the nesting burrows of the Taiko.
- b) To assess the threats to survival of Taikos at their breeding places, and recommend corrective action.

METHODS:

Radiotelemetry was used to track Taikos in the suspected breeding area. Although it was anticipated that most transmittered Taikos would be non-breeders without burrows, it was hoped that a few would go to ground. Having found burrows, the status and effects of potential predators in their neighbourhood were studied.

INTERIM RESULT:

In late 1987, 12 Taikos were captured and 10 of these were fitted with transmitters, in the Tuku-a-Tamatea valley in the south-west of Chatham Island. Tracking of these revealed that two went to ground. Subsequent searches in dense bush resulted in the discovery of 5 burrows in two areas 4 apart, where the transmittered birds had landed.

Potential predators in these areas were feral cats, wekas, feral pigs and ship rats. Possums were potential competitors for burrows.

INTERIM CONCLUSIONS:

Taikos nest in burrows in the bush in the southern part of Chatham Island. Burrows are widely scattered in small groups. More burrows should be found, and some may be in unknown areas. A further search using radiotelemetry should be carried out. It is not yet clear what is limiting the population and thus preventing its increase (which the food supply would surely allow). Weka predation of chicks is one possibility. Feral cats are a serious threat. Further study is needed, but this must not prevent management being undertaken as a matter of some urgency.

TITLE: Black Petrel fledglings translocation from Great Barrier Island to boost the colony on Little Barrier Island

PROJECT LEADER: M. J. Imber

PROJECT: Black Petrel (*Procellaria parkinsoni*) fledglings are being transferred between the two surviving colonies of this species which is endemic to New Zealand. These transfers began in 1986.

OBJECTIVES:

- a) To boost the population of Black Petrels on Little Barrier Island, which was reduced to a critical level by feral cats but is now safe, by transferring fledglings from Great Barrier Island where the population is very productive but potentially endangered by the human population (further introductions of predators, fire risk).
- b) To gain knowledge about transferring petrels from one colony to another, and to assess its success, in case of more urgent need elsewhere.

METHODS:

Using knowledge gained from a study of the breeding biology of Black Petrels on Little Barrier Island, fledglings were selected from burrows on Great Barrier Island. These fledglings were sufficiently heavy that they would not depart for at least several days, so that they might become imprinted on their new home, yet old enough not to require feeding by hand (or to need only a few feeds).

Receptor burrows on Little Barrier Island were those not occupied by locally reared chicks. Most of these burrows had been disused since the 1970's when there was a severe decline of these petrels because of predation by cats.

INTERIM RESULT:

In the 3 years of transfer, 1986-1988, a total of 146 fledglings has been transferred. No mortality has been observed during or soon after the transfer, but 4 birds were lost from the transfer crate in 1987. In 1986 and 1988 the birds were transferred inside the helicopter. Transferred birds are not expected to return to breed until 1990 onwards.

INTERIM CONCLUSIONS:

These petrels adapt well to the upheaval of the transfer. Transfers should be carried out for 2 more years as originally planned, so that about 250 birds will have been shifted.

TITLE: Current status and reasons for the decline of rockhopper penguins at Campbell Island.

PROJECT LEADER: Philip Moors

OBJECTIVES:

- a) To determine the timing and extent of the severe population decline, and whether it is continuing.
- b) To define the present breeding success and survival of the penguins.
- c) To investigate the cause(s) of the decline and identify what management actions can be taken.

METHODS:

Dated photographs and field observations, especially from the 1940s and have been compared with the present situation in order to gauge the past population and the extent of the decline. At study colonies, nest inspections, weighing programmes and banding are providing data on breeding performance, chick growth and survival. Diseases of the penguins are being studied with bacteriology and histopathology, and diet with the wet-offloading technique.

INTERIM RESULTS:

- a) The rockhopper penguin population has declined over 90% since the 1940s; there are now about 55,000 breeding pairs in 9 main colonies.
- b) Sites of deserted colonies can be identified by chemical analysis of soils.
- c) Breeding success is relatively low and varies between years, as does the rate of chick growth.
- d) The penguins feed mainly on small fish.
- e) *Pasteurella multocida*, a bacterial infection, kills chicks and adults.
- f) Average sea temperatures during the breeding season have increased significantly since the mid-1940s.

INTERIM CONCLUSIONS:

- a) Rockhopper penguins at Campbell Island have a different diet to other populations of the species.
- b) The population decline is likely to be due to warming of the seas, with consequent effects on the type, distribution or abundance of food.
- c) These oceanographic changes may also be linked with declines of mollymawks and elephant seals at the island.

TITLE: Colony size and productivity of Hutton's shearwaters

PROJECT LEADER: Greg Sherley

OBJECTIVES:

1. Map the distribution of Hutton's shearwater in the Seaward Kaikouras.
2. Estimate the number of breeding pairs of shearwater.
3. Estimate the productivity of the colonies.

METHODS:

Colony boundaries are plotted on a 10" to the mile aerial photograph. Quadrats (10 x 10m) are placed within each significant colony and burrows scored: chick active this season, unused and entrance only. Areas of colonies are calculated using a planimeter and quadrat data are combined with these areas to estimate productivity and colony size.

INTERIM RESULTS:

Colonies in the Kowhai River Catchment have been mapped, productivity assessed and numbers of breeding pairs estimated. These data are outstanding from the Shearwater Stream colonies which occur in considerably smaller numbers. Productivity is approximately 25-30% and breeding pairs in the Kowhai Catchment probably number less than 150,000. These figures should not be quoted at this stage.

TITLE: Grey-faced petrel chick production on Whale Island.

PROJECT LEADER: Malcolm Harrison

PROJECT: To monitor the annual chick population.

OBJECTIVES:

- a) To estimate the number (with confidence levels) of chicks reared to fledgling per burrow in a controlled stable study area.
- b) To continue a long term random banding project for this species.

METHODS:

Chicks are caught and banded as they emerge from their burrows at night to exercise during the two weeks before they leave the island. Mark capture/recapture techniques are applied to make an estimate of their numbers. Burrow counts are related to this estimate to give chicks per burrow.

INTERIM RESULTS:

Chick production varies from year to year. Some of this variation can be correlated with the abundance of rats but there is much left to explain.

Long term changes in the vegetation of the island have recently started with the eradication of goats and then more recently rabbits. The effect of the changing vegetation is confounded by changes in the weather patterns -forecast to be long-term also.

INTERIM CONCLUSIONS:

The control of rats at specific times of the year can enhance chick production. This could have relevance to any consideration of further exploitation of this traditional Maori food -the northern mutton bird.

TITLE: An early warning alarm and peak-meter detection system for improving radio tracking.

PROJECT LEADER: M. Douglas.

OBJECTIVES:

- a) To design a detection and alarm system for the early warning of weak transmitter signals at base stations.
- b) To provide an amplitude measurement method that records accurately the peak signal level of a transmitter.

METHODS:

Laboratory design of circuit. Construction and testing of proto-type. Construction of 6 units for 1987 Chatham Island Taiko field programme. Evaluation of their use. Any further development for future work.

INTERIM RESULTS:

Six units were used during 1987 operation.

- a) Alarm unit: worked successfully. Resolution of detection at noise level of receivers.
- b) Peak-meter: worked successfully. Range of resolution compressed and not as good as ear for detection of weak signals. Moving targets, noise and operational difficulties degraded its value.

INTERIM CONCLUSIONS:

- a) A very useful device where long term monitoring of a channel is required. Can be used to detect individual transmitters and future interface with a portable computer a possibility. Some improvement in reduction in noise detection may be possible with future development.
- b) The peak-meter unit design is a useful additional tool for accurate transmitter amplitude measurement. More work is required to improve its noise rejection and value for highly mobile animal tracking operations, such as the Taiko.

TITLE: Tuatara-Kiore relationships on Lady Alice Island

PROJECT LEADER: Don Newman

PROJECT: Aspects of the population ecology of tuatara (*Sphenodon punctatus*) and kiore were studied on Lady Alice Island between 1980 and 1984; low intensity monitoring of the populations continued until 1987. The acceptance by kiore of variously presented and lured non-toxic baits was tested.

OBJECTIVES:

- a) To study the population ecology of tuatara and kiore in an area where both co-exist.
- b) To collect information on the size distribution, burrow use, dispersion, movements and density of the tuatara population.
- c) To document habitat use, breeding, fluctuations in density, structure and diet of the kiore population.
- d) To test the acceptance by kiore of variously presented and lured non-toxic baits.

METHODS:

- a) Detailed records were kept of the contents of 120 study burrows established in an area behind Grave Bay, NW coast of the island. Tuatara and birds caught in the burrows were marked, but not kiore.
- b) Night searches for tuatara and kiore were made in the vicinity of study burrows and an attempt made to catch all tuatara seen.
- c) A rat kill-trap line (50 traps) was set on the southern slopes of the island above South Cove. Kiore caught were autopsied on the island their stomachs (food analysis) and heads (ageing from tooth-wear) were preserved.
- d) The acceptance by kiore of variously presented and lured non-toxic bait was tested.

INTERIM RESULTS:

- a) population density of tuatara in the study area was calculated to be 100 tuatara/ha, less than 7% of that occurring in forest remnants at Stephens Island.
- b) The capture of some sub-adult tuatara in the study area indicated that recruitment is occurring, but analysis has yet to be undertaken to determine if this recruitment is sufficient to maintain the population.

- c) No remains of tuatara were found in the stomachs of 240 kiore trapped on the island; fragments of skinks, *Leiolopisma* spp., which are roughly the size of hatchling tuatara, were located in three rat stomachs.
- d) Wounds on a hatchling tuatara discovered dead on the island, appeared to have been inflicted by kiore.
- e) Numbers of kiore caught fluctuated seasonally, low numbers being caught in late spring and summer, and high numbers in late autumn, through winter, to early spring.
- f) The kiore from Lady Alice Island are heavier than any recorded elsewhere in New Zealand, or overseas (males : mean weight = 136.1g, range = 80-187g, n = 77; females : mean weight = 104.7g, range = 56-150g, n = 74).
- g) Kibbled grains and petrogel paste are acceptable as baits to kiore; bait lures apparently acceptable to the kiore include aniseed, banana, coconut, clove, eucalyptus and vanilla.

TITLE: Ecology of Hamilton's Frog on Maud and Stephens Islands

PROJECT LEADER: Don Newman

PROJECT: Information on the size distribution, activity, dispersion and population densities of Hamilton's frog on Stephens and Maud Islands were compared. Field work, which commenced in 1975 (Stephens Island) and 1977 (Maud Island), was completed respectively in 1978 and 1983.

OBJECTIVES:

- a) To estimate the size of the Stephens Island Hamilton's frog population.
- b) To determine the habitat requirements of the frog, paying special attention to climate.
- c) To collect information on the activity, movements and growth rates of the frog.

METHODS:

- a) Searches at night for frogs were made following a particular path within their Stephens Island habitat (= frog bank) and in two plots in the lower part of the Maud Island forest.
- b) Captured frogs were photographed (for identification), weighed, measured and afterwards returned to their capture site. All capture sites were mapped and straight-line distances between successive captures of individuals were measured.
- c) Prior to each night's search for frogs, the following environmental measurements were made : temperature (dry and wet bulb), rainfall over the previous 24 hours, wind direction and velocity, and an index of light intensity.
- d) On Maud Island, ground cover and substrate at the two study plots were recorded.

INTERIM RESULTS:

- a) No difference in size or weight appears to occur between individuals of the two populations.
- b) Minimum adult size is not reached until at least the fifth year.
- c) The frogs are nocturnal and their activity is best accounted for by relative humidity, vapour pressure deficit and dew point.

- d) On Maud Island, frog capture sites are positively correlated with rocky ground cover.
- e) Frogs limit their activity on the surface to small areas (median distance between successive captures of individuals which may overlap with those of other individuals).
- f) The population densities of adult frogs were calculated to be 58 frogs/100m² on Stephens Island and on Maud Island 29 frogs/100m² (rock substrate highly clumped) and 131 frogs/100m² (dispersion of rock substrate random).

INTERIM CONCLUSIONS:

- a) Rocks provide frogs with shelter from climatic extremes, retreats from predators, and suitable nest sites. Any attempts to establish new colonies of the species must involve the location, or creation, of rocky habitat, preferably under forest.
- b) It is unlikely that the effective population size of the frog on Stephens Island exceeds 500 individuals.

RECOMMENDATION:

An attempt to increase the size and distribution of the Stephens Island population should be made by creating further rock habitat in the vicinity of the frog bank.

TITLE: Biology and habitat requirements of MacGregor's skink (*Cyclodina macgregori*) on Mana Island

PROJECT LEADER: Don Newman

PROJECT: Information is being sought on the general biology and habitat requirements of McGregor's skink on Mana Island so that recommendations can be made regarding the conservation of existing populations and the possible establishment of additional colonies to improve its prospects of long term survival.

OBJECTIVES:

- a) To determine the habitat requirements of McGregor's skink.
- b) To collect information on the size distribution, dispersion, movements and density of the Mana Island population.
- c) To obtain data on the diet and on the breeding biology of the species.

METHODS:

Pitfall trapping is being used to locate sites where McGregor's skink occur. Captured lizards are weighed, measured, marked, then released alongside the trap where they were caught. Aspect, vegetation and substrate will be recorded at successful trap sites and micro-climates in these areas will be monitored. Droppings of the skink will be preserved and later analysed to try to identify foods of the lizard.

INTERIM RESULTS:

- a) Over 22 trapping sessions made since January 1986, 172 captures of 64 individual McGregor's skinks have been made.
- b) In spite of traps having been set at many sites around the island, all captures of the skink have been made along a small area (2 ha) of the island's NE coast.
- c) McGregor's skinks showed signs of heat stress much more readily than other lizard species when handled on warm days.
- d) Mice are present on the island and reach high densities from mid-summer through autumn. During autumn, the rodents were seen to kill and eat lizards the size of juvenile McGregor's skinks.

INTERIM CONCLUSIONS:

On Mana Island McGregor's skink have a restricted distribution, narrow habitat tolerance and, relative to other lizard species on the island, are large. All these features have been identified as characteristic of extinction-prone species.

INTERIM RECOMMENDATION:

Consideration should be given to attempting to eradicate mice from Mana Island.

TITLE: Conservation status and ecology of the dark-eyed gecko
Hoplodactylus kahutarae

PROJECT LEADER: Greg Sherley

OBJECTIVES:

- a) Design a survey technique to find dark-eyed gecko
- b) Search for dark-eyed gecko in likely areas and gauge its status.
- c) Make preliminary observations on its habitat requirements and ecological characteristics as far as possible.

METHODS:

Likely habitat is searched by day to plan a search route for night spotlighting. Two people are used: when one sees an eye reflection the other ventures to catch the animal to identify and if necessary take standard anatomic measurements. Search effort has been recorded systematically.

INTERIM RESULTS:

A method for searching for the geckos has been designed. Their probable preferred habitat has been determined and the best conditions to search for them. So far no geckos have been found outside the Kahutara Saddle hills where it was found by Whitaker. No geckos were found on its original discovery site in the Shearwater Stream.

TITLE: Lizard translocation research: *Cyclodina whitakeri* on Korapuki Island

PROJECT LEADER: David Towns

PROJECT: Protocols for island transfers of endangered lizards are being developed which address questions of genetic identity, maintenance of heterozygosity, minimum viable population size and habitat selection. The long-term goal is to use endangered lizards as a model when planning the rehabilitation and management of small offshore island ecosystems.

OBJECTIVES:

- a) To develop techniques and planning criteria for the rehabilitation of island ecosystems.
- b) To eliminate kiore (*Rattus exulans*) and rabbits from 18 ha Korapuki Island.
- c) To measure the response of resident lizard populations to removal of an introduced predator and to compare this with neighbouring islands where predatory rodents remain, and where they have never been present.
- d) To measure the microhabitat conditions under which the endangered skink, *Cyclodina whitakeri* occurs on Middle Island.
- e) To establish *Cyclodina whitakeri* from Middle Island on Korapuki Island in appropriate microhabitats following rodent eradication.

METHODS:

Rodent eradication is being undertaken using specially designed poison dispensing silos. Lizard population densities and composition are being studied using pitfall traps along fixed transect lines on Middle Island (rodent free), Korapuki Island (rodent eradication) and Stanley Island (rodents still present). Ecological genetics of the scattered populations of *Cyclodina whitakeri* are being studied using allozyme analysis of blood, muscle and liver tissue in collaboration with the Genetics Unit, Victoria University of Wellington; invertebrate community structure on Korapuki Island is being studied in collaboration with Soil Bureau, DSIR; vegetation changes on Korapuki Island are being studied in collaboration with Botany Division, DSIR.

Microhabitat conditions (temperature and humidity) are being studied on Korapuki and Middle Islands using electronic data loggers.

INTERIM RESULTS:

- a) Rats were eliminated in November 1986 by poisoning and all rabbits on the island were shot by August 1987.
- b) Korapuki Island locally supports high densities of lizards which are diurnal and live in coastal areas. Forest dwelling species are rare and large ground-dwelling skinks of the genus *Cyclodina* are absent. Lizard densities are low everywhere on Stanley Island. Middle Island supports high densities of lizards in coastal and forest habitats and is distinctive for its high biomass of *Cyclodina* skinks.
- c) None of the three populations of *Cyclodina whitakeri* can be distinguished on genetic criteria, despite the geographic range of 500 km.
- d) Twenty five *Cyclodina whitakeri* were transferred from Middle to Korapuki Island in February 1988 into an area whose suitability was determined from microhabitat data and invertebrate density.

INTERIM CONCLUSIONS

- a) Korapuki Island is undergoing a rapid change in vegetation structure following removal of rabbits.
- b) Despite the removal of rats from Korapuki, resident lizard distributions have not undergone measurable change with forest areas still supporting very low lizard densities.
- c) Forest habitats represent "empty" habitats for lizards on Korapuki Island, making them suitable for the introduction of forest species such as *Cyclodina whitakeri*, as long as these transfers are conducted soon after rodent removal.

PUBLICATIONS:

- Towns, D.R. 1988 Rodent eradication from islands -the conservation potential. Forest and Bird 1988: 32-33
- Towns, D.R., Daugherty, C.H., Pickard, C.R. in press Developing protocols for island transfers: a case study based on endangered lizard conservation in New Zealand. Proceedings of the International Workshop on Herpetology of the Galapagos. University of New Mexico Press.

TITLE: Captive Rearing of *Powelliphanta* Land Snails

PROJECT LEADER: Kath Walker

PROJECT: The requirements for captive rearing, and the growth rates and breeding biology of captive snails from 17 *Powelliphanta* subspecies were investigated as part of a project initiated by the Wildlife Service in 1984.

OBJECTIVES:

- a) To find the conditions necessary to breed *Powelliphanta* in captivity.
- b) To describe aspects of the biology of the genus that cannot be studied in the wild.

METHODS:

Snails of a variety of *Powelliphanta* subspecies were kept in leaf litter and moss in outdoor cages. The amount of shade, water, lime, and food were varied until mortality ceased and the snails started to breed. Snails were weighed and measured and the cages searched for eggs at monthly intervals.

INTERIM RESULTS:

(a) Conditions for captive breeding

Snails survived and bred in cages in deep shade which were watered for an hour each day. Dolomite lime and fresh leaf litter were added to the cage every 2 months. They were fed exotic pasture worms and native "milk" worms at monthly intervals. Worms reared in compost bins were not suitable *Powelliphanta* food, as they did not survive in the cages.

(b) Biology

The mating behaviour, laying times and sites, clutch and eggs sizes, incubation periods, and growth rates of juveniles were recorded for many taxa. Methods of feeding, and patterns of activity with respect to time and weather were noted.

This project is complete except for writing up.

INTERIM CONCLUSIONS:

Given intensive care most *Powelliphanta* can be kept and bred in captivity.

TITLE: Studies of *Powelliphanta* (giant land snail) populations by mark and recapture.

PROJECT LEADER: Kath Walker

PROJECT: The population biology, movements and growth rates of populations of *Powelliphanta hochstetteri bicolor* on Blumine Island in the Marlborough Sounds and *P. lignaria johnstoni* at Charming Creek in Buller were investigated as part of a project initiated by the Wildlife Service in 1984.

OBJECTIVES:

- a) To describe the population biology, patterns of movement, and growth rates of healthy populations of land snails to provide background information for the conservation and management of endangered *Powelliphanta* snails.
- b) To determine the decay rate of empty shells for future population density surveys.
- c) To determine the changes in the snail populations following the removal of wekas from Blumine Island.

METHODS:

Permanent study plots of 20 x 20 m were established under forest in each study area. Each year in late summer the plots were searched and all snails found were marked, weighed, measured, and their position within the plot recorded. The shells of five freshly dead snails were placed beside the study plot in 1984 and photographed annually.

INTERIM RESULTS:

(a) Charming Creek

Snails live for between 15 and 20 years. They show random patterns of movement and can move up to 60 m in a year. Predation was insignificant until the winter of 1987 when kakas or keas ate many of the adult snails in the study plots

(b) Blumine Island

Snails grow at similar rates and have similar patterns of movement to the Charming Creek snails but were originally at a much lower density. There has been a 400% increase in snail density and a marked change in population structure since the beginning of the study which was coincident with the removal of wekas from the island.

After a further year's data collection the results will be analysed and written up.

INTERIM CONCLUSIONS:

- a) High levels of predation may occur intermittently on the mainland.
- b) *Powelliphanta* populations can suffer high levels of predation even from natural predators.
- c) Dramatic increase in snail populations can be achieved by removing wekas from islands.
- d) The population structure of *Powelliphanta* changes in the presence of predators.
- e) Empty shells take more than 4 years to decay in both wet and dry climates.

TITLE: A Review of the Systematics of the Genus *Powelliphanta*

PROJECT LEADER: Kath Walker

PROJECT: The systematics of the land snail genus *Powelliphanta* is being reviewed using electrophoresis and analysis of morphometric, biogeographical and ecological information.

OBJECTIVES:

- a) To produce a classification of the genus which accurately reflects its phylogeny.
- b) To reassess the conservation priorities of the genus in the light of the revised classification.

METHODS:

Up to 5 live snails of all but the rarest *Powelliphanta* taxa have been collected. Allozyme electrophoresis will be used to examine the genetic variation within and between the taxa.

Information on distribution, ecology, and morphometrics has been gathered while collecting the live snails and during previous studies of the conservation status of the various taxa.

INTERIM RESULTS:

Snail extraction techniques and suitable tissues and stains have been determined for electrophoresis of *Powelliphanta*.

Trial runs have shown that *Powelliphanta* provide good material for electrophoresis and about 30 genetic loci are available for analysis.

New information on distribution, ecology and morphometrics has shown that the existing classifications are inadequate, in particular the genus cannot be lumped into one or two species as the most recent taxonomic revision has proposed.

TITLE: Conservation genetics of NZ parakeets

PROJECT LEADER: Sue Triggs

PROJECT: Levels of genetic variation, diversity, and hybridisation among and within populations and species of NZ parakeets were determined using protein electrophoresis.

OBJECTIVES:

- a) To determine the genetic divergence among the species of parakeets (*Cyanoramphus*) and among populations within species.
- b) To determine the degree of hybridisation between Forbes and red-crowned parakeets on Mangere Island.
- c) To determine the specific status of the orange-fronted parakeet.

METHODS:

Samples representing all four species and all subspecies (except the Kermadec Island red-crowned parakeet) of NZ parakeets were analysed for genetic variation by protein electrophoresis.

RESULTS:

- a) Forbes parakeet is genetically distinct from mainland yellow-crowned parakeets.
- b) Despite extensive hybridisation, Forbes parakeets are still genetically distinct from Chatham Island red-crowned parakeets.
- c) Evidence of hybridisation between mainland red-crowned and yellow-crowned parakeets was found on Little Barrier Island.
- d) Captive populations of parakeets showed evidence of extensive hybridisation and low genetic variation.
- e) Southern populations of yellow-crowned parakeets are genetically distinct from northern populations.
- f) A small sample of orange-fronted parakeets were not significantly different genetically from yellow-crowned parakeets in the same area.

CONCLUSIONS:

- a) Forbes parakeet should be raised from a subspecies to a species.
- b) parakeets appear to have remained a distinct genetic unit on Mangere Island in spite of hybridisation with red-crowned parakeets. This suggests that hybrids back-cross to red-crowned parakeets and/or the present management programme to protect Forbes parakeets by reducing numbers of red-crowned and hybrid parakeets has been successful.
- c) Hybridisation between species occurs to a small extent even in undisturbed habitats.
- d) Captive-bred parakeets should not be used to establish new, wild populations.
- e) No conclusion could be reached on whether the orange-fronted parakeet is a colour morph of the yellow-crowned parakeet or a separate species.
- f) The present captive-breeding programme for the orange-fronted parakeet, which interbreeds orange-fronted parakeets with genetically different captive yellow-crowned parakeets, is not suitable for the conservation of the wild orange-fronted parakeet genetic type.

TITLE: New Zealand National Banding Scheme

PROJECT LEADER: R O Cossee

PROJECT: To direct, administer, and regulate bird banding in New Zealand and to administer several related schemes like the Waterfowl Shooting Diary and Australasian Seabird Mapping Schemes.

OBJECTIVES:

To effectively administer all bird banding activity in New Zealand, to purchase and provide to operators capture, marking and banding equipment, to control training and registration of banding operators and to facilitate the design and field testing of specialised banding methods.

To manage the data held under the schemes and to provide raw data, summaries, frequency tables, material for life tables and completed analyses to scientist and managers for conservation, management or control purposes.

To obtain accurate information about movements and habits of birds.

INTERIM RESULTS:

During 1987/88 26,497 birds of 105 species were banded in New Zealand, 434 previously banded birds were re-banded: 15,676 (59.2%) of the new birds were game species and 10,821 (40.8%) non-game species.

The total number of birds banded in New Zealand up to 31 March 1988 is 1,012,135; the total number of species banded is 224. One previously not banded species, Leach's fork-tailed petrel, was banded during the year.

A total of 12,040 recoveries was added to the computer files: 2,735 records (22.7%) were for birds recovered dead and 9,307 (77.3%) for birds recovered alive. A total of 3,923 (32.6%) had been recovered at least once before. Live recoveries consisted of 2,144 (23%) game birds and 7,163 (77%) non-game birds. Of the repeat recoveries 727 (18.5%) were game species and 3,196 (81.5%) non-game species. Dead and live recoveries combined for each species group are 4,324 (35.9%) and 7,761 (64.1%) respectively.

A number of computer programmes were developed and run to provide managers, both within and outside the Department of Conservation, with raw data, summaries, frequency tables, material for life tables and completed analyses. Some of these activities were of international importance.

During the year bird banding in New was regulated by 29 active individual permits and 26 institutional/group permits.

TITLE: A battery testing system.

PROJECT LEADER: M. Douglas.

OBJECTIVES:

- a) To test reliability and capacity of various batteries (general and telemetry) that are used in DOC field work.
- b) To provide results of these data for DOC use.

METHODS:

- a) Laboratory test batteries of different manufacturers, batch, and capacity, at different current drains. For simultaneous battery monitoring, a data-logging system is needed.
- b) Field test telemetry batteries.
- c) Summarise results for circulation.

INTERIM RESULTS:

- a) Results of first tests have been compiled. These need to be repeated under different conditions. Some new batteries are currently being tested. Purchase of a data-logger required.
- b) Field testing has been completed on all but 2 telemetry batteries.

INTERIM CONCLUSIONS:

Manufacturers often supply inadequate technical information on their products. A standardised testing procedure is required for comparison of different manufacturers batteries. Radio-telemetry requires very reliable data on batteries that are not often provided by the manufacturers.

TITLE: An acoustic timer for sampling animal activities.

PROJECT LEADER: M. Douglas.

OBJECTIVES:

- a) Design a pocket sized low power timer for observer scan sampling of animal behaviour, e.g. feeding.
- b) Field test
- c) Publish design.

INTERIM RESULTS:

Pro-type designs field tested in previous employment at Auckland University. Final design currently in use by D.S.I.R. Completed writing up. Art work presently being photographed. Paper ready to submit to journal.

INTERIM CONCLUSIONS:

A useful device for researchers in ecology and animal behaviour. Currently about 10 in use in various institutions. Can be used also to trigger automatic sampling equipment such as motor-drive cameras and video equipment.

PROGRAMME 60: HARVESTED AND CONTROLLED PLANTS

- 10 Native Plants
- 20 Maori Plant Resources
- 30 Introduced Plants
- 40 Problem Plants (Weeds)

TITLE: Problem weeds in protected natural areas

PROJECT LEADER: Susan Timmins

OBJECTIVES:

- a) To investigate weed dynamics in protected natural areas.
- b) To offer advice on problem weed management in reserves.

METHODS:

- a) Reserve characteristics with respect to weediness were extracted from biological survey of reserves reports. Transects across reserve boundaries will be established.
- b) Information, both formally published and otherwise, on weed ecology and control is collected and dessiminated on request.

INTERIM RESULTS:

- a) The most important factors influencing the weediness of reserves, are proximity to towns, and setting. These both reflect proximity to source of propagules associated with intensifying land use. The most vulnerable reserves are small, narrow, remnants, with clearings, on fertile soils, and close to towns.
- b) With the establishment of the new department some conservation officers have responsibility for weed control but have limited experience on which to draw. It is useful to have repositories of knowledge to which they can turn. To date advice has been on an ad hoc basis.

RECOMMENDATIONS:

Packages of suitable material should be prepared and distributed to those requiring good information on which to base day to day management decisions and policy. The packages should include current knowledge on weed control and ecology, both of specific species and in general.

Lines of responsibility (science/management) should be clarified.

TITLE: Management techniques for maori resources: totara

PROJECT LEADER: Philip Simpson

OBJECTIVES:

- a) To understand the available resource, the level of demand and appropriate uses of totara timber.
- b) To identify ways to sustain the totara resource, particularly through planting.
- c) To provide educational material on the historical and present significance of totara, both botanically and as a cultural resource.

METHODS

Eastern Region has employed a contract worker to investigate the size and nature of the totara resource particularly in Central North Island. Marae meetings have been held to examine ways for Maori representatives to assess the validity of requests for totara -Support for planting totara (Whakaruruhau: The Marae Tree Planting Programme) has been obtained from numerous through visits, conferences and other communications.

INTERIM RESULTS:

- a) Survey of totara resource has been underway for 2 months A report will be prepared by Eastern Region.
- b) Whakaruruhau, has wide Marae support and Prime-ministerial support. A by DOC to grow totara for pilot schemes is urgently
- c) A publication on the uses, values and ecology of totara has been written (The Landscape, in press). A publication of Whakaruruhau is in draft form.

INTERIM CONCLUSIONS:

- a) Opportunity exists to enhance the use of totara for traditional Maori uses, but this must be associated with conservation measures.
- b) The best conservation measure is to plant forests of totara.

PROGRAMME 70: HARVESTED AND CONTROLLED ANIMALS

- 05 Introduced Mammals (excluding ungulates)
- 10 Ungulates
- 15 Domestic Animals
- 20 Gamebirds
- 30 Introduced Birds
- 40 Native Fish, Freshwater
- 50 Introduced Fish
- 60 Introduced Invertebrates
- 70 Maori Animal Resources
- 80 Population Models, Monitoring Systems

TITLE: The eradication of kiore (*Rattus exulans*) from Rurima Rocks, Bay of Plenty, by experimental methods.

PROJECT LEADER: Ian McFadden

PROJECT: Techniques to eradicate kiore from small islands were sought because these rodents have the potential to reduce the numbers of some indigenous plants and animals to a significant extent.

OBJECTIVE: To develop techniques to eradicate kiore from small islands.

METHODS:

In August 1983, 1080 (sodium monofluoroacetate) was laid on Rurima Island using presentation and baits (kibble grain in automatic feeding silos) found to be acceptable to kiore during previously conducted trials. In January 1984, the anticoagulant bromodialone was substituted for 1080.

INTERIM RESULTS:

- a) After each of three successive applications of 1080, little or no toxic bait was taken by kiore.
- b) Following substitution of bromodialone for 1080, a good take of bait was recorded. Since June 1984, after four applications of bromodialone, no rat sign has been observed on the island.

INTERIM CONCLUSIONS:

- a) The anticoagulant bromodialone, but not sodium monofluoroacetate, is an effective rodenticide.
- b) Dependent upon island topography (accessibility), the techniques developed can be used to eradicate kiore from islands of up to about 20 ha in area.

TITLE: The ecology and economic impact of feeding by Canada geese on farmland.

PROJECT LEADER: K.J. Potts

PROJECT: Two part study focusing on geese roosting on Lake Grassmere, North Canterbury.

- a) Feeding study including feeding in the lake and on adjoining farmland.
- b) Using food consumption estimates derived from feeding study, the costs incurred by farmers calculated on basis of reduced stock carrying capacity and grass margins (critical impact periods and the relative cost significance of feeding on particular pasture/crop types integral to investigation).

OBJECTIVES:

Study (a): to contribute towards a theoretical basis for managing geese on farmland e.g. with respect to sacrificial cropping, advising farmers where to site vulnerable crops etc.

Study (b): to give managers a detailed account of how geese reduce profits on a particular farm -how costs breakdown in relation to seasonal impact and in relation to overall farm economy.

METHODS:

Feeding study was carried out monthly for two years. A computer based feed budget modelling technique was conjunction with the Centre for Resource Management (Lincoln College) to determine reductions in stock carrying capacity due to geese.

INTERIM RESULTS:

Feeding study

- a) Geese preferred certain food types at particular stages of the year. Preference was influenced by spatial arrangement i.e. with respect to distance from the lake, degree of disturbance etc.
- b) Disturbed paddocks unused in the daytime were often exploited at night.
- c) Indications were that the degree of feeding carried out at night was much higher than for similar studies carried out in Europe and North America.

Economic study.

- a) The goose 'problem' is not one of volume of food consumed but of timing of the impact.
- b) Less than one percent of all goose feeding carried out at Grassmere was on turnips, yet this accounted for 83 of the 95 stock units calculated to have been displaced. The very extensive feeding carried out on pasture was relatively inconsequential within the Grassmere context.
- c) Due to the large numbers of site specific variables involved in the calculations, generalisation from the results must proceed with caution. Certainly the special nature of farming operations and economics in the South Island high country must first be taken into account.

TITLE: Mortality and survival rates of grey and mallard duck in New Zealand.

PROJECT LEADER: T.A. Caithness

PROJECT: Mallards especially, and in some areas grey duck, are the principal gamebirds in New Zealand. Over 30 years there has been a marked population change from grey dominance to mallard dominance. This event could have been caused by differential mortality and survival rates between the two species and, or, marked differences in fecundity.

OBJECTIVES:

- a) To determine whether or not mallards through their expansion phase had more favourable mortality and survival rates than the declining grey duck.
- b) To determine whether or not the survival rates for grey duck are in phase with its reproductive ability.

METHODS:

About 110,000 grey and mallard duck have been banded since 1956, about 20% of these have been shot. Using the current US Fish and Wildlife Service life table models analyse these data by cohort and test for differential mortality and survival rates through here decades.

INTERIM RESULTS:

Preliminary analysis indicates that while mallard survival has been superior to that of grey duck, the differences are not of sufficient magnitude to cause the marked population change in the two species.

INTERIM CONCLUSION:

As the mortality and survival rates of mallard and grey duck are relatively similar, it seems that the expansion of mallards is due to the biological advantage it has over grey duck in having a larger clutch size of 13 eggs, compared with 10 for grey ducks.

TITLE: Waterfowl hunting season summary

PROJECT LEADER: T.A. Caithness

PROJECT:

An annual report of the hunting statistics from some 1,700 hunters. Each acclimatisation society is treated separately and these data form the sole basis for assessing hunter success in relation to bag limits, season length and species composition and any changes that may be promoted in these.

OBJECTIVES:

- a) To establish and maintain a data base on hunter success and population trends with each species of waterfowl.
- b) To keep the hunters and administrators informed on local population trends for each species and explain the biological processes that contribute to good and bad hunting seasons.

METHODS:

Since 1968, some 1,700 hunters from a random sample of 2,500, regularly return a diary of their hunting results. These are computer coded and analysed annually for each acclimatisation district in New The analysis shows the average result obtained by the hunters for opening weekend, the rest season and the whole season. The species composition and percentage each species makes of the bag are also shown for each facet of the season. About 36 pages of tables and discussion in relation to the season and comments on the questions asked by the hunters form the basis of the summary.

INTERIM RESULTS:

The results obtained permit estimates of the total population of each species available for hunting each season. These data are then used for setting bag limits and season lengths.

INTERIM CONCLUSIONS:

The waterfowl summary written in a popular style, has over 20 years brought science into game-bird management. The discussion sections have progressively removed many of the myths and misconceptions that lay people often hold with game birds. This information has resulted in vastly more relaxed hunting restrictions and hence enjoyment for the hunter.

TITLE: Mortality, survival and movements of the NZ Shoveler.

PROJECT LEADER: T.A. Caithness

PROJECT: World-wide only five species of shoveler are recognised but only in New Zealand have sufficient numbers been ringed to permit reasonable estimates of mortality, survival and movements to be made.

OBJECTIVES:

- a) To establish estimates of mortality and survival rates of NZ shoveler, an important low-land game bird.
- b) To determine by movement analysis whether or not NZ shoveler should be managed as a regional or national resource.

METHODS:

More than 4,000 NZ shoveler were banded between 1972 and 1983. Nearly 800 of these have been returned by hunters a return rate similar to other dabbling ducks. Preliminary estimates of mortality and survival rates have been made using Brownie and Estimate models on part of the data set. A more sophisticated analysis of the full data set is currently being done by the US Fish and Wildlife Service.

INTERIM RESULTS:

Preliminary estimates of mortality and survival indicate that an annual mortality rate of 40% for adults and 55% for juveniles are equitable with the reproductive rates of NZ shoveler. Movement analysis indicates a high level of mobility by these birds.

INTERIM CONCLUSION:

NZ shoveler because of their nomadicism should be managed as a national resource. There is no evidence to suggest that hunting is in any way inhibiting the population.

TITLE: Population studies and movement of canada geese in the South Island.

PROJECT LEADER: K.J. Potts

PROJECT: Banding and colour-coded neck collaring programmes established throughout the South Island for the purpose of identifying population sub-groups and patterns of movement within and between such groups. This line of research is undertaken in combination with the annual trend counting flights to assess regional patterns of population change. Project ongoing.

OBJECTIVES:

To provide goose managers in South Island with information on the effectiveness of regional culling operations, including possible displacement effects. The identification of the geographical ranges of particular sub-groups provides a basis for selective population control.

INTERIM RESULTS:

- a) The canada goose population in the South Island consists of several sub-groups which exhibit varying degrees of interchange and overlap.
- b) The establishment of traditions pertaining to the use of particular breeding areas and mass roosting lakes clearly of fundamental importance in maintaining sub-group identity.
- c) Population trends with respect to the South Island as a whole, coast vs. high country and nine arbitrarily defined regions have been described.

TITLE Reproduction, movement and stock differentiation in smelt (*R. retropinna*) in Lake Taupo.

PROJECT LEADER: R.T.T. Stephens

PROJECT: Some Ngati Tuwharetoa people want the opportunity to fish for smelt as a substitute for the traditionally fished koaro which were decimated by introduced rainbow trout. Smelt fishing is prohibited. This study examined where and when smelt would be vulnerable to fishing and identifies controls required to protect smelt and angling interests if a smelt fishery were allowed to develop.

OBJECTIVES:

- a) To describe seasonal and diurnal patterns of shoreline smelt abundance.
- b) To describe spawning habits.
- c) To determine whether Taupo smelt are a single population or composed of several stocks.

METHODS:

- a) Smelt were sampled at beach and stream stations fortnightly by day and by night.
- b) Quantitative samples of smelt eggs were collected fortnightly using a corer.
- c) Variations in breeding habits, size, number of vertebrae and isozyme structure were used to test for stock heterogeneity.

INTERIM RESULTS:

- a) Smelt are abundant in shoreline areas by day from November until May.
- b) Smelt leave shoreline areas by night.
- c) Smelt spawn along beaches and in streams from October until March.
- d) There was significant variation between spawning smelt in timing of spawning, egg size, numbers spawned, adult size and numbers of vertebrae.

TITLE: Estimation of avoidance by small pelagic fish from a quantitative sampling device.

PROJECT LEADER: R.T.T. Stephens

PROJECT: The goal is to develop a sampling technique suitable for estimates of smelt production and hence carrying capacity for trout in Central North Island lakes. The report awaits modifications following reviewers comments.

OBJECTIVES:

- a) To measure avoidance with respect to smelt size and net diameter.
- b) To calculate correction factors for catch data to generate unbiased estimates of population size frequency distribution.
- c) To identify features of avoidance behaviour.

METHODS:

Three different sized dropnets, weighted to descend at 0.92ms^{-1} were fished in rotation to collect 16 replicate samples with each net. The ratio of catches from different sized nets was used to develop a model describing avoidance in terms of fish size, net diameter, descent speed and filtration efficiency.

FINAL RESULTS:

- a) Net avoidance was significant for smelt longer than 25mm.
- b) Net avoidance was described by an exponential function of smelt size and net diameter.
- c) Corrections for avoidance substantially increased estimates of smelt density and smelt biomass.
- d) Avoidance behaviour was determined by perception of the approaching net and selection by the smelt of the optimum escape route only when the whole net could be seen.

FINAL CONCLUSIONS:

Dropnet catches, if corrected for avoidance, can be used to estimate limnetic smelt production, but only for the size range of smelt actually captured.

INTERIM CONCLUSIONS:

- a) Smelt are most vulnerable to beach seine fishing by day when spawning near beaches and streams in spring and summer.
- b) Lake Taupo smelt are comprised of many stocks which home to specific spawning areas at a particular time of year.
- c) A prohibition on smelt fishing for the spawning season is the minimum requirement to protect smelt and angling interests.

TITLE: Fishes of the Te Arai Stream

PROJECT LEADER: R.T.T. Stephens

PROJECT: The East Coast Catchment Board is preparing a water allocation plan. The draft plan makes inadequate provision for values. This investigation described fishery values associated with the stream and assessed the impact of abstraction on fish abundance.

OBJECTIVES:

- a) describe the fish fauna of the Te Arai Stream.
- b) assess the impact of the water supply intake on fish abundance.

METHODS:

Selected reaches from the headwaters downstream to the mouth were sampled by electro-fishing to establish the composition of the fish fauna. Effects of the water supply intake were assessed by comparing fish densities at three sites, one above and two below the intake. Within site variation was estimated by dividing each site into five long reaches.

FINAL RESULTS

- a) Species present were bullies, common bullies, long-finned eels, short-finned eels, inanga, smelt and torrent fish.
- b) The fish fauna was dominated by Cran's bullies and long-finned eels.
- c) Reduced densities of Cran's bullies and long-finned eels were associated with abstraction at the water supply intake.

FINAL CONCLUSION:

A minimum flow should be provided below the intake at all times.

TITLE: Determination of rainbow trout distribution and production in Lake Taupo.

PROJECT LEADER: Martin Cryer

PROJECT: The distribution, abundance, production, and potential productivity of the rainbow trout (*Salmo gardneri* Richardson) population in Lake Taupo and its tributaries. To be conducted on contract for DOC as a National Research Advisory Council Fellowship.

OBJECTIVES:

- a) To determine the spatio-temporal distribution patterns of trout in Lake Taupo.
- b) To determine the age-, size-, and location-specific diets of trout in the lake.
- c) To estimate the annual productivity of trout and major forage species such as smelt in the lake.
- d) Model the fishery to predict the consequences of present and future patterns of exploitation.

METHODS:

The distribution and abundance of trout is being investigated using a computer-interfaced split-beam echo sounder. Auxiliary information on size distribution, and diet of trout is being derived from fish captured in gill nets. Areas of the lake inaccessible to the sounder (<20m depth) are being surveyed by SCUBA divers on manta boards. Prey fish are being surveyed using a drop net (offshore), and a purse seine ("littoral"), with some extra information from the sounder.

INTERIM RESULTS:

(a) Distribution studies

The sounder has been successfully fitted to "Koaro", and calibrated for use in the fresh water of Lake Taupo. One full survey of the lake has been completed (90 lkm transects in a stratified random design), and a rough estimate of the size of the population of approximately one million individuals derived.

(b) Diet studies

The specialised nets and techniques necessary to this study have been successfully acquired. Gill netting has been conducted at 5 sites, and 114 trout stomachs have been retained for future analysis.

(c) Prey fish studies

Expertise in drop netting and purse seining has been acquired, but no quantitative surveys have yet been undertaken.

TITLE: Experimental fisheries management in the Rotorua Lakes

PROJECT LEADER: Peter Mylechreest

PROJECT: The continuing management commitment to stock the Rotorua Lakes annually with hatchery-reared rainbow trout from the Ngongotaha Hatchery has been used in an experimental way between 1979 and 1986.

OBJECTIVES:

To test enhancement potentials for improving the 'return to the angler' of hatchery-reared (and wild) rainbow trout in terms of numbers, size and quality of fish.

To identify detrimental environmental and genetic influences affecting the growth of trout in the Rotorua Lakes.

METHODS:

Monitoring of trout growth and the forage fish populations in the lakes has been developed since 1980, and a succession of experimental liberations of tagged hatchery reared rainbow trout have focused on:

- 1979 the heritability of the seasonal timing of spawning.
- 1981 age-at-maturity and its effect on growth.
- 1982 the seasonal timing of liberation of hatchery fish.
- 1983 Tarawera selective breeding programme.
- 1985 the effects of increased stocking rate of hatchery fish on the forage fish populations and trout growth in Lake Okareka.
- 1985 pair cross breeding trials for age-at-maturity.
- 1987 the selectivity of stream-mouth angling.

INTERIM RESULTS:

The study at the Te Wairoa stream-mouth, Lake Tarawera, (April to June 1987) revealed intense angling selectivity on large male rainbow trout.

Follow up of the progeny from the 1985 pair cross breeding trials at age 2 (winter 1987) suggests a stronger paternal than maternal influence on age-at-maturity.

A review of the causes, and effects on secondary production, of nitrogen limitation in the lakes suggests a major environmental threat to the growing conditions for trout in the Rotorua Lakes.

INTERIM CONCLUSIONS:

Substantial benefits to the trout fisheries of the Rotorua Lakes can be obtained from:-

- Genetic selection in the hatchery fish.
- Aquatic protection of wild stocks (e.g. Tarawera outlet spawning sanctuary, and compulsory release of male rainbow trout at the Te Wairoa stream-mouth) and enhancement of wild stock (e.g. Wairua waterfall manipulation).
- Modification of land use practices in lake catchments.

PROJECT NO: S7050/185
CORPORATE OBJECTIVE NO: 13

TITLE: Feeding habits of rainbow trout in Lake Taupo

PROJECT LEADER: R.T.T. Stephens

PROJECT: The diet of trout has not been described since smelt were liberated in 1934 to supplement forage resources. Interactions between smelt and trout are unknown.

OBJECTIVES:

- a) To describe seasonal and size related variations in the diet of rainbow trout.
- b) To identify feeding preferences.
- c) To identify interactions between smelt and trout.

METHODS:

Stomachs from trout caught by anglers and in gill nets were collected and their contents were separated, identified and measured. Smelt lengths were compared with those of smelt sampled using a beach seine net.

INTERIM RESULTS:

- a) Smelt comprised about 85% of the diet which also included bullies, insects and crayfish.
- b) Crayfish were most common in the diets of large trout.
- c) When smelt were concentrated near the lakeshore for spawning, trout consumed most by volume and selected large smelt.

INTERIM CONCLUSIONS:

- a) Smelt are the principal forage resource for Taupo rainbow trout.
- b) Shoreline concentrations of spawning smelt attract feeding trout to places where they are accessible to anglers.

TITLE: Flow management for fish and angling in the Tongariro River

PROJECT LEADER: R.T.T. Stephens

PROJECT: The effects of flow regulation on trout and angling in the lower Tongariro River were investigated to determine how flows could be managed to protect or enhance the trout fishery.

OBJECTIVES:

To identify effects of the Tongariro power scheme (TPS) on the flow regime and fishery of the lower river.

To identify factors influencing angling success.

To identify factors limiting numbers of trout running into the river.
To determine relationships between flow and habitat.

METHODS:

(a) Flow regime and fishery

Flow records, numbers of trout trapped annually and angler surveys before and after the TPS was built were compared.

(b) Angling Success

Multiple regression was used to identify associations between angler catch rates and flow, water clarity, numbers of trout, angling method, area fished, familiarity and experience.

(c) Trout numbers

Annual fish traps counts were correlated with potentially influential events (floods, ova collection, fry and fingerling releases) during previous years. Life history studies were used to indicate how these events affect trout.

(d) Relationship between flow and habitat

The extent of physical habitat, defined by depth, current speed and bottom composition, was measured in four reaches. Hydraulic modelling indicated how these and hence habitat area change with flow.

INTERIM RESULTS:

- a) TPS has reduced flood frequency, magnitude and duration and causes brief flow reductions.
- b) Trout numbers increased slightly, but they became less catchable.
- c) Trout were more easily caught at low flows.
- d) Most trout which contribute to the fishery leave tributary streams when 9 to 15 cm long.
- e) Adult trout numbers were influenced by summer flood frequency three years earlier. Summer floods cause juvenile mortality.
- f) The optimum flow for food production was between 11 and 28 cumecs.

INTERIM CONCLUSIONS:

- a) The TPS has caused some changes to the fishery, but these have not diminished its value for angling.
- b) Production of juvenile trout exceeding 9cm in length determines subsequent numbers of adult trout available to the fishery.
- c) Higher winter flows, lower summer flows, prolonged recessions and elimination of sudden, brief flow reductions would enhance trout habitat and may increase trout numbers.

TITLE: Birds as a hazard to aircraft.

PROJECT LEADER: T.A. Caithness

PROJECT: This study is ongoing and embraces all airfields where passenger carrying aircraft may land. Environmental features, natural and man-made which attract birds to the vicinity of airfields are monitored by irregular inspections. As the need arises, specific case studies are made.

OBJECTIVES:

To contain and or reduce conflicts between birds and aircraft on NZ airfields.

METHODS:

Analyse quarterly, all bird-strike data emanating from pilots, engineers and ground staff and compare with historical data. Significant changes result in on-site inspections to determine cause of change and, where possible, recommend means of overcoming the problem. Evaluate promising techniques, materials etc designed to reduce bird problems as they come to hand.

INTERIM RESULTS:

- a) Contribute biological overview of national and local bird-strike statistics in a quarterly report to the aviation industry, civil and military.
- b) Inspect all airfields and, where necessary, report with recommendations to aerodrome licensees.
- c) Destroy nesting black-backed gulls at Napier.
- d) Calibrate helicopter application of granular insecticide for Nelson, Wellington, Wanganui and Ohakea airfields. Successfully conclude case for milliscreening sewage at Wellington Airport.
- e) Represent NZ at International Bird Strike Conference, Madrid, Spain.

INTERIM CONCLUSION:

DOC involvement with birds as a hazard to aircraft will be ongoing but with unpredictable highs in involvement depending on changing local features, rubbish dumps, farming activities, invertebrate build-ups etc.

PROGRAMME 80: HUMAN ECOLOGY; SOCIAL SCIENCE

- 05 Archaeology
- 10 Historic Sites Excavation, Survey, Inventory
- 15 Historic Site Management
- 20 Artefact Preservation
- 25 Stratigraphy
- 40 Landscape Ecology
- 45 Demography
- 50 Economics
- 55 Recreation, Tourism, Survey and Monitoring
- 80 Naori Cultural Values
- 85 Institutional Systems
- 90 Human Impacts

TITLE: Archaeological excavation at Opononi

PROJECT LEADER: Joan Maingay

PROJECT: A 'rescue' excavation at a partially disturbed work-floor and midden site, on the southern shore of Hokianga Harbour.

OBJECTIVES:

- a) To determine the existence/extent of in situ deposits.
- b) To record and recover archaeological evidence.
- c) To provide preliminary information on an area that has received little archaeological attention.

METHODS:

- a) Survey of property
- b) Survey collection of artefacts.
- c) Test pitting and subsequent excavation of selected areas.

INTERIM RESULTS:

- a) Surface collection comprised largely of obsidian flakes and cones; one stone trolling-Wre shank; a few fragments of moa bone; several historic artefacts.
- b) A substantial hangi pit an part of an associated midden discovered in situ.
- c) Further subsurface finds of obsidian but no distinct features apart form hangi.

INTERIM CONCLUSIONS:

The site appears to have been a summer fishing camp, with extensive evidence of flake tool manufacture.

Data from the analysis of midden and artefacts can be usefully compared with another recently excavated site on the southern Hokianga shore.

TITLE: Archaeology in the Waitangi Forest, Bay of Islands

PROJECT LEADER: Robert Brassey

PROJECT: The investigation of historic records and field evidence of Maori and European settlement in the Waitangi Forest and vicinity.

OBJECTIVES:

- a) To record potential archaeological sites from historic records.
- b) To identify and record these and other archaeological field evidence.
- c) To prepare a scientific report on the above.

METHODS:

- a) Study of archaeological site records, aerial photos, published and unpublished historic records, maps, photos, etc.
- b) Interviews with local knowledgeable people, including Maori elders, Forestry staff, historians.
- c) Field survey for visible surface evidence.

INTERIM RESULTS:

- a) Identification of four early historic Maori settlements
- b) Mapping of field evidence of volcanic cones and field systems now under forest.
- c) One of the above four settlements is under heavy scrub and not able to be identified.
- d) Report on the above in draft.

INTERIM CONCLUSIONS:

- a) Much of the Waitangi Forest area was not inhabited in prehistoric and early historic times.
- b) There were, however, local areas with sites of considerable importance, that warrant excavations and further study of field evidence.
- c) Attention should be given to these in order that their condition under scrub or forest, can be established and their protection or investigation provided for.

TITLE: Archaeology at Wood's Flour Mill

PROJECT LEADER: Joan Maingay

PROJECT: An archaeological investigation of the ruins of Francis Wood's 19th century flour mill. This is one of the very few remaining early industrial sites in Whangarei City. It has been bought by Whangarei City Council as an historic reserve.

OBJECTIVES:

- a) To recover and record subsurface evidence associated with the site, prior to stabilisation of the remaining walls.
- b) To determine the type of waterwheel and course of the water-race.
- c) To discover any subsequent use of the building.
- d) To stabilise the existing structure for public presentation.

METHODS:

- a) Three weekend excavations with voluntary labour.
- b) Information on the site collected from local historians and residents.
- c) Conservation of some excavated material.
- d) Stabilisation of basement structure.

INTERIM RESULTS:

- a) A few items of machinery associated with the mill were recovered by excavation, and the course of the mill-race determined from old plans.
- b) Stratified deposits were found on a terrace adjacent to the site.
- c) A concentration of metal debris was discovered in the basement area, with charred wood and molten glass spread over the whole floor.

INTERIM CONCLUSIONS:

Proposed historic sequence -

- a) The mill was driven by a high breast-shot wheel, and had a wooden superstructure above the stone basement.
- b) The building was subsequently used as a brewery.

c) The upper storey burnt down after the brewery was abandoned.

Further historical research is needed to confirm dates of the last two stages in the sequence.

Stabilisation of the walls has yet to be undertaken. It is presently proposed to employ an Access group working under a stonemason.

PROJECT NO: S8005/16
CORPORATE OBJECTIVE NO: 3

TITLE: Archaeology in the Waitangi National Reserve

PROJECT LEADER: Clayton Fredericksen

PROJECT: Archaeological and historical sites in order to provide for them in the development and management of the Reserve.

OBJECTIVES:

- a) Identify archaeological sites in order to provide for them in the development and management of the Reserve.
- b) Investigate the sites as a part of the presentation of the history of the Reserve.
- c) Contribute to the understanding of the history and pre-history of the Bay of Islands.

METHODS:

- a) Study of existing site records and archaeological reports relating to the general area.
- b) Historic research to identify sites.
- c) Field survey and test excavations to establish location and extent of sites.
- d) Investigate in detail through excavation and analysis the evidence of selected sites.

INTERIM RESULTS :

- a) Preliminary field survey March 1988 -30 sites.
- b) Historical research - 14+ sites.
- c) Preliminary report final draft (6-88).

INTERIM CONCLUSIONS:

- a) Archaeological sites of high historical interest including village relating to "Treaty House", a pa, earlier mission settlement, and Maori gardens next to river.
- b) Also probably sites of earlier Maori settlement.
- c) Further research proposed.

TITLE: Archaeology at the Fisher Road Site

PROJECT LEADER: Russell Foster

PROJECT: Investigation of an undefended settlement, part of a 15 ha group of settlement clusters (others - Westfield site and Hawkins Hill).

OBJECTIVES:

- a) To obtain evidence of settlement in the fields around Te Apunga o Tainui, a neighbouring volcanic cone.
- b) To add to evidence of a nearby site in the same general cluster.
- c) To add to the very inadequate evidence of the settlement of the volcanic fields of Tamaki (Auckland).

METHODS:

- a) Selection for excavation of features with habitation evidence in good condition -terraces, middens, pits.
- b) Areas of features hand excavated then strategic machine trenching and scraping to extend stratigraphic and aerial records.

INTERIM RESULTS:

- a) Interim report published 1986.
- b) Scientific report on excavations and analysis of materials, in final draft.

INTERIM CONCLUSIONS:

- a) The methods of investigation were very productive, i.e. hand excavation supplemented by machine trenching and scraping.
- b) Complex settlement evidence was uncovered, with three contrasting areas in terms of activity and structures.
- c) The three sites were contemporary, complementary aspects of settlement.
- d) The three sites were contemporary with other sites in the vicinity (Westfield, Hawkins Hill), possibly forming part of a very extensive settlement.

TITLE: Archaeology at the Cryers Road Site, East Tamaki

PROJECT LEADER: Clayton Fredericksen

PROJECT: The excavation of possible settlement features at the Cryers Road Site.

OBJECTIVES:

To establish the form and function of selected features, including terraces with shell deposits, walled terraces, and platforms with shell deposits. This site was unusual for the large proportion of features that were possible settlement, especially with shells.

METHODS:

- a) Excavation based on detailed field evidence mapped and analysed (Albert 1987).
- b) Hand excavation of selected features.
- c) Machine scraping and trenching of possible settlement areas without surface features. (1987).

INTERIM RESULTS:

- a) One terrace with deep stratified habitation deposits indicating many brief episodes.
- b) A habitation area with extensive shell deposit near the perimeter of the lava field.
- c) Shell mound function not established with oven cooking debris.
- d) Shell on platform of unknown function
- e) Water source nearby
- f) Terrace little or no indication of use, some natural 'walls'
- g) Knoll with brief habitation evident

INTERIM CONCLUSIONS:

- a) Settlement temporary, possibly camping near water source.
- b) Settlement sparse in this part of fields, in spite of the apparent field evidence.

PROJECT NO: S8005/26
CORPORATE OBJECTIVES NO: 3

TITLE: Survey of early historic sites in Auckland area.

PROJECT LEADER: Kaye Green

PROJECT: (a) Research to locate and evaluate 19th century sites of European settlement, industry and commerce, in the Auckland region.

(b) To identify sites for investigation by archaeological techniques.

OBJECTIVES:

- a) This is a follow-up of work by Best in 1986-7 to identify sites of the original 1840 waterfront.
- b) 1987-8 work was intended to expand into the inner city area to identify key sites which could yield information to supplement, expand and correct the historic records of the social and economic life of 19th century New Zealand.
- c) It is seen as a part of a larger general survey to be eventually expanded to include industrial archaeological sites and further research into 19th century Maori settlement.

METHODS:

Historic research into contemporary records, maps, drawings, newspapers and modern thesis and research essays.

Research into land titles, police census, street directories to establish the exact history of each site

Inspection of current buildings to establish presence of basements, pilings, etc likely to damage archaeological remains.

Preparation of NZAA site record form for each site investigated, and in depth report on selected sites.

INTERIM RESULTS:

Eighty areas, ranging from one lot to a city block in size, have been investigated -25 have been studied in some detail and reports prepared, including -

New Zealand's first Supreme Court and Crown goal

New Zealand's first parliament

Chancery Street Block -1840 houses, a bakery, a forge and the mechanics institute.

Fort Ligar, the earliest military establishment in Auckland -1845 - with remains still extant.

House of the Colonial Secretary, Willoughby.

INTERIM CONCLUSIONS:

- a) Extremely effective in locating intact sites that expand knowledge of colonial Auckland.
- b) Well warrants a continuing programme.
- c) An aspect of archaeology in New Zealand of very great interest to the public.

TITLE: Archaeology of Kawau's Historic Copper Industry

PROJECT LEADER: Rod Clough

PROJECT: Investigation of the Smelting House ruins and related features on Kawau Island.

OBJECTIVES:

- a) Establish what archaeological features are present inside the Smelting House.
- b) Establish what archaeological features exist in the vicinity of the Smelting House.
- c) Establish research into the copper industry on Kawau including other archaeological sites and features.

METHODS:

- a) Excavation of the areas to be used for shoring footings as part of the effort to stabilise the ruins (November 1987).
- b) Survey and test excavation of other internal features.
- c) Test excavate the entire site of the smelting industry, including both the reserve and adjacent private land (continuing).

INTERIM RESULTS:

- a) Measured drawings of the site done by Leatherby and Morgan 1986.
- b) Location of sand casting-floor and slag-block furnace foundations established.
- c) Traces of the smelting process recovered: ore, slag, matte and furnace bricks undergoing analysis.
- d) Located structural remains near mine (South Cove).

INTERIM CONCLUSIONS:

- a) Smelting methods transplanted from Wales involved smelting of ores in several stages.
- b) Coal and bricks were imported from Australia and refractory bricks from England.
- c) Need for further survey and test excavation to study industry properly. In particular, extend the work to areas near the mine (South Cove) and the associated settlement in Miners Bay (South Bay).
- d) The social history of the industry is important, as well as technological history.

TITLE: Archaeology at the General Assembly Site, Auckland

PROJECT LEADER: Ian Smith

PROJECT: Archaeological investigation of New Zealand's first Parliament building, later the Auckland Provincial Council Chambers, offices for various Government Departments and the Auckland University College.

OBJECTIVES:

- a) To clarify the location, size and shape of the original building and subsequent extensions, none of which were clearly indicated by available documentary and pictorial records.
- b) To recover a sample of artefacts relating to the construction, modification and use of the buildings.
- c) To design a plan for appropriate landscaping of the site.

METHODS:

- a) Historic research to assemble and collate available records.
- b) Excavation of selected portions of the site.
- c) Identification and analysis of ceramic, glass, metal and other artefacts recovered.

INTERIM RESULTS:

A brief summary of results has been published in the Hauraki Gulf Maritime Park magazine (Winter 1988). Excavation revealed the location, size and shape of the original building and uncovered, among other things, a cellar beneath the first Parliament's Bellamys. A wide range of artefacts were recovered, including a previously unrecorded type of ceramic foundation pile. Analysis of the artefacts and a detailed report on the excavation are nearing completion.

INTERIM CONCLUSION:

Most of the artefacts recovered appear to relate to the final phases of the buildings life, and will provide a useful comparison with assemblages from other mid-late 19th Century buildings in Auckland. A plan for landscaping the reserve, based on excavation data, has been approved in principal by developers of the land adjacent to the site.

TITLE: Archaeology at New Zealand's First Supreme Court and Goal.

PROJECT LEADER: Simon Best

PROJECT: Archaeological investigations of the site of New Zealand's first Supreme Court and Goal.

OBJECTIVES:

- a) To investigate selected parts of the site to obtain evidence of the social and economic way of life relating to the goal, including the residences of the goalers and the structure of the goal buildings.
- b) To investigate the Ligar Canal in terms of its form and probable midden contents.
- c) To investigate the prison well with a view to obtaining stratified materials to elucidate the socio-economic life of the goal.

METHODS:

- a) Historic research.
- b) Excavation of selected areas.
- c) Trenching of other areas.
- d) Monitoring and recording during construction of new building foundations.

INTERIM RESULTS:

- a) Recovery of significant portions of the cell block, kitchen, and stone breaking floor.
- b) Recovery of new information on the location and building of the Ligar Canal.
- c) Location of older course of the Waihorotiu Stream and recovery of early Maori site from stream bank.

INTERIM CONCLUSIONS:

- a) The research techniques in identifying locational identity of sites were valid predictions of the presence of the sites.
- b) Material recovered expands and corrects historic record, and demonstrates the incomplete nature of historic records.
- c) The public interest in such significant colonial sites is enormous.

TITLE: Archaeology at the Pollen Pottery and Brickworks

PROJECT LEADER: Simon Best

PROJECT: Investigations at the site of one of New Zealand's first commercial brickworks and the potteries of James Wright, one of New Zealand's earliest recorded potters.

OBJECTIVES:

- a) Recover archaeological data regarding these early industries including the layout of the site and technological information, prior to development.
- b) Recover samples of ceramic products in order to establish a comparative collection for later identification of material produced at these works and found at other locations in New Zealand (using chemical and mineral analysis).

METHODS:

- a) Hand-probe and magnetometer survey to locate features related to the industries.
- b) Test excavations to define the extent of the site (Best 1986).
- c) Hand excavation of features located in survey.
- d) Machine excavation of overlying burden and for testing in areas where features not detected by other methods.
- e) Detailed study of artefacts including scanning electron microscope and X-ray diffraction analysis for characterisation of products (proposal for 1988-89).

INTERIM RESULTS:

- a) Two types of kiln excavated: a simple clamp and more advanced Scotch kiln.
- b) Remains of pugmills and other clay processing installations recovered.
- c) Circular paths of crushed brick around the mills and the presence of horseshoes indicate that they were operated by horse power.
- d) Potters wasters dump excavated producing evidence of the range of ware manufactured and numerous potters tools (some signed).

INTERIM CONCLUSIONS:

- a) There were many modifications and technological innovations during the life of the works, necessitated by both wear and tear and the rapidly changing economic climate in Auckland.
- b) There was more than one potter operating at the site, and they were producing both commercial and domestic wares. Some of the domestic wares were lead-glazed.
- c) Coal was imported to the site as fuel for the kilns.
- d) Products of the brickworks included a variety of bricks and field tiles. Bricks were both hand-moulded and wire-cut. Field tiles were extruded and lime mortar was also produced by calcining shells from both midden and natural deposits.
- e) Fuel, lime and other products were all transported to and from the other site via Whau Creek.

TITLE: Archaeology and Environment in New Zealand

PROJECT LEADER: B.G. McFadgen

PROJECT: Updating the archaeological component of my Ph.D thesis and preparing publication.

OBJECTIVES:

Publication.

METHODS:

Analysis of archaeological remains dated by stratigraphic correlation with widespread natural events such as sand dune building phases, earthquakes and volcanic eruptions.

INTERIM RESULTS:

Stratigraphic framework has been published.

INTERIM CONCLUSIONS:

Results do not support long drawn out cultural change in New Zealand prehistory. They instead indicate a short sharp period of change about 400 to 500 years ago.

TITLE: Description and interpretation of late holocene coastal dune stratigraphy on Chatham Island

PROJECT LEADER: B.G. McFadgen

PROJECT: Coastal erosion of formerly stable sand dunes around the east, north and west coasts of Chatham Island has exposed many kilometres of vertical sections through the dunes. The sections contain clearly defined buried soils and the bones of fish, sea mammals and birds, and the remains of human occupation. Correlation of the stratigraphy with that in similar environments on the New Zealand mainland may help ascertain the causes and role of climate in dune building. The opportunity for proper scientific study is shortlived because of renewed dune accumulation which is reburying the sections.

OBJECTIVES:

- a) To record, correlate and interpret stratigraphy in wave-cut sections.
- b) To collect and interpret faunal remains from deposits dating before and after human settlement.
- c) To map and interpret soils and former lake and sea shorelines.
- d) To correlate stratigraphy with mainland New Zealand.

METHODS:

Field recording using sea-rafterd pumices and radiocarbon dating for correlation, mapping geomorphological features from aerial photographs and infilling detail from ground surveys.

INTERIM RESULTS:

Three sand dune building phases within the last 2000 years are recognised based on the stratigraphy and ground soil development on the dunes. They are tentatively correlated with dune building phases on the New Zealand mainland.

Large numbers of sea mammal bones have been collected from within the dunes and have been identified as Hooker's sea lion.

Remains of human occupation are consistently found in the upper buried soil but never in the lower buried soil

INTERIM CONCLUSIONS:

Human settlement of Chatham Island occurred about 450 years ago. One of the casualties of human occupation was Hooker's sea lion which was locally extinct at the time of European settlement.

TITLE: Investigation of archaeological stone row system

PROJECT LEADER: B.G. McFadgen

PROJECT: Investigation of late Holocene geology and archaeology at Black Rocks in Palliser Bay, and at Clarence River mouth in Marlborough, to determine environmental conditions during time of Polynesian settlement. Using knowledge of geological history and deposits, to determine sources of stone in stone rows, extent of soil disturbance between stone rows, and origins of features such as pits in the vicinity of the stone rows.

OBJECTIVES

Correlation of beach ridges and, as appropriate, river terraces and fan deposits; dating of geological events; determination of stone row construction, nature of soils between and adjacent to stone rows, sources of stones, origins of nearby large pits.

METHODS:

Standard geological and archaeological methods of determining and correlating stratigraphic sequences.

Archaeological excavation methods were used to determine the structure of stone rows.

Pedological methods were used to determine whether or not soils between stone rows had been cultivated.

INTERIM RESULTS:

Stone rows were built for a specific purpose using stones gathered from borrow pits. They were not a by-product of cultivation of ground between the rows.

Evidence of soil cultivation between the rows was absent at the Palliser Bay site. At the Clarence site the ground showed evidence of transported sand and is presumed to have been cultivated.

INTERIM CONCLUSIONS:

Stone rows were not constructed as a by-product of kumara cultivation. It is considered unlikely that kumaras were cultivated in Palliser Bay during the Archaic period.

PROJECT NO: S8005/244
CORPORATE OBJECTIVE NO: 3

TITLE: Sourcing of Obsidian from NZ archaeological sites and inferences about the Obsidian trade in prehistoric NZ.

PROJECT LEADER: B.G. McFadgen

OBJECTIVES:

Characterisation of NZ obsidian sources and determination of the area of over which obsidian from each source was traded.

METHODS:

Rapid non-destructive XRF analysis of surface collection and excavated obsidians from archaeological sites.

INTERIM RESULTS:

Some 6000 obsidian flakes have been sourced from sites throughout NZ and from the Kermadec Island group.

INTERIM CONCLUSIONS:

Mayor Island obsidian reached the Kermadec group some 600 years ago.

The most widely distributed obsidian in New Zealand is from the Mayor Island source. All sources except Waihi had been discovered and were in use by about 650 years ago.

Obsidian along the eastern North Island coast appears to have been transported by sea.

Elsewhere it appears to have been overland.

TITLE: Maori settlement pattern and horticulture in the eastern North Island

PROJECT LEADER: Kevin Jones

OBJECTIVES:

- a) Mapping and recording of archaeological sites in key river catchments of the eastern North Island.
- b) Provide account of settlement and horticulture distribution as a contribution to regional prehistory.
- c) Notify landowners of existence of sites.

METHODS:

- a) Foot survey and recording.
- b) Examination of older aerial photographs.
- c) Recording of Maori names for sites, where available.
- d) Modelling of distribution and quantitative data on sites relevant to horticulture, especially kumara storage pits.
- e) Studies of historical documents such as 18th Century European voyaging records.

INTERIM RESULTS:

- a) Since 1982 map ing and site recording has been completed for some 10,000 km² of intensive Maori settlement, comprising the catchments of the Uawa (Tolaga Bay), Pakarae, Waipaoa/Waikohu, Maraetaha, Wairoa, Waiotahi, Waimana/Whakatane, Rangitaiki and Tarawera Rivers.
- b) The principal Maori crop, kumara, because of the small-scale, labour-intensive regime in which it was grown, was exploited in a large variety of sites, including
 - alluvial fans, both on silt loams and coarse, free-draining ash soils with high water tables,
 - inland dunes,
 - coastal terrace lands such as occur in the eastern Bay of Plenty,

- ridge crests in inland, frost-prone districts,
 - silt loam colluvium.
- c) Settlement reached greatest concentrations on alluvial fans within several hours canoeing distance of the coast.
- d) 400 sites registered (formally notified to landowners) under 5.43 of Historic Places Act 1980.

INTERIM CONCLUSIONS:

Riverine settlement was important in all periods of the Maori occupation of New Zealand.

The key "ecotones" were between coast, river, alluvial fans and inland wetlands.

RECOMMENDATIONS:

Further work on superficially destroyed archaeological sites on alluvium and colluvium is needed, since the condition and prospects for survival of such sites is not known.

TITLE: Settlement patterns in the Wanganui River Valley 1839-1864

PROJECT LEADER: A. Walton

PROJECT:

A study, based on documentary sources (supplemented by fieldwork), of the settlement pattern along the Wanganui River and tributaries between about 1839 and 1864.

OBJECTIVES:

- a) To document settlement size and distribution, and how this changed during the 1840s, 1850s and 1860s.
- b) To reconstruct the social organisation of the inhabitants of Wanganui River and tributaries.

METHODS:

The study is based on documentary sources. This includes a number of censuses of full or partial censuses of the population conducted by missionaries, or by the Government, last century. The censuses are compared one with another, and with information from other sources, to assess the reliability of the information.

The locations of settlement sites have been pinpointed as closely as possible, with some sites having been inspected in the field.

Information on subsistence activities, seasonal movement of the population, conflict between groups, and the role of chiefs has also been collected. This information addresses current issues in the understanding of social organisation.

INTERIM RESULTS:

A rough draft of the population size and distribution paper has now been put on word processor.

A paper, "Maraekowhai: a mid-nineteenth century settlement on the upper Wanganui River" NZAA Newsletter 30:249-262 (1987), has been published.

INTERIM CONCLUSIONS:

The population of the Wanganui River and tributaries was of the order of 4000 people in the 1840s and 50s. Most of the population lived below the Mangaiti confluence and there was a particularly large cluster of people living in the Hiruharama-Pukehika 'area. The population of Pukehika, the largest settlement in the early 1840s, had dispersed to a number of nearby smaller settlements by the early 1850s. The population on the upper river was of the order of 300, and the settlements were small and scattered.

TITLE: Archaeological Site Distribution

PROJECT LEADER: Brian Sheppard

PROJECT: Techniques are being developed to study the distribution and implications for archaeological studies, of archaeological sites recorded in the Archaeological Association's site recording scheme.

OBJECTIVES:

A project, in two parts:

- a) to develop programs for computer plotting of archaeological site locations on to maps and overlays, and
- b) to interpret the significance of the distributions.

METHODS:

Records from the NZ Archaeological Association's site recording scheme are sorted by computer into meaningful groups and plotted on to suitable map bases. The information will be studied to assess its significance to land management and site protection needs. The significance will also be assessed for an interpretation of regional and national patterns of early settlement and land use.

INTERIM RESULTS:

Computer programs were developed and tested for use with the IBM System/34 and IBM PC, used by the NZ Historic Places Trust. The method was further developed to simplify production of the Trust's series of County Inventories of Historic Places. By the end of the 1987-88 financial year, further development had ceased pending transfer of this operation to Wang equipment provided for DOCNet.

INTERIM CONCLUSIONS:

The techniques so far developed have proved to be very effective tools for plotting locations of archaeological sites on to maps or overlays. They are now in use for management, planning and research purposes and are seen to be of a form easily adaptable for use with other map-based information systems that the Department may wish to develop.

TITLE: Development of computer programmes for site recording and investigation.

PROJECT LEADER: B.G. McFadgen

PROJECT: The evaluation of the PSION hand-held computer as an electronic fieldbook for site recording and archaeological excavations.

OBJECTIVES:

- a) To develop programs for recording of relevant data.
- b) To assess the usefulness of the computer for recording data in the field.

METHODS:

Evaluation is based on use of the computer in a field situation.

INTERIM RESULTS:

The first model used gave considerable trouble and was prone to crash under field conditions for reasons which were never fully understood. A later model was tried and seems to behave under field conditions.

The small size of the keyboard makes the computer unsuitable for site recording where there is a lot of text to be entered.

Although the computer has not yet been used for excavation recording, its use may be limited here by its inability to be used for sorting records. It is anticipated that for recording results for downloading to a larger computer, it will be satisfactory.

INTERIM CONCLUSION

The computer is not recommended for site recording.

TITLE Archaeology in the volcanic fields of Auckland.

PROJECT LEADER: S Bulmer

PROJECT: The investigation, through mapping and archaeological excavation, of the features in remaining volcanic field sites.

OBJECTIVES:

- a) To map in detail and analyse the settlement and garden features in two areas proposed for permanent preservation.
- b) To review the field evidence from the other volcanic field sites and compare with Otuaataua and Matukurua.
- c) To excavate selected features to establish their form and function.

METHODS:

- a) Mapping from aerial photos and field checking.
- b) Archaeological excavation (by hand)
- c) Analysis of charcoal for wood identification.
- d) Analysis of shell and bone material.
- e) Analysis of stone technology.

INTERIM RESULTS:

- a) Analysis of field evidence in proposed reserve, Matukurua -A Sullivan.
- b) Traditional history of Matukurua -A Sullivan.
- c) Technical report on Otuaataua (now with Minister, but intended for general circulation) - with B Tubb (DOC Planner).
- d) Conference paper - Prehistoric settlement patterns in the volcanic fields of Tamaki, published A review of research results to date.
- e) Background paper for Minister on two proposed reserves.
- f) Gardening in Tamaki -in progress - A Sullivan.

INTERIM CONCLUSIONS:

- a) The complexity of the field systems.
- b) The complexity of settlement form.
- c) The high significance of the proposed reserves is confirmed.

TITLE: Archaeology of the volcanic cone pa of Auckland

PROJECT LEADER: Susan Bulmer

PROJECT: Archaeological investigation of the volcanic cone pa of Auckland, a unique group of sites of national and international importance. Pre-urban settlement amongst largest in country, settlement size and organisation and relationship to each other.

OBJECTIVES:

- a) Production of detailed archaeological maps of all extant sites.
- b) Reconstruction of now destroyed sites through mapping from aerial photos and collation and study of other records.
- c) Analysis of field evidence of cone pa.
- d) Detailed investigation of selected sites as a basis for the future presentation of an example to the public.
- e) Preparation of scientific papers on the field evidence and stratigraphy evidence of the cone pa.

METHODS

- a) Drawing maps from aerial photo stereos to reconstruct now destroyed sites (ongoing).
- b) Collation and field checking of University prehistory study plus survey maps (ongoing).
- c) Excavation of selected areas of sites during necessary maintenance work in reserves.
- d) Detailed programme of research to be planned -
 - (i) Research problem oriented on a number of sites:
 - (ii) Single selected site for intensive investigation and presentation.

INTERIM (1987-8):

- a) Four site maps redrawn and revised (3 produced as pamphlet in Heritage Week 1988).
- b) Study of state of preservation of field evidence of 13 sites - B Sewell

- c) Completed draft of analysis of field evidence - seminar paper to be submitted for publication.

INTERIM CONCLUSIONS:

- a) Further map revisions need to be done towards a complete set.
- b) Urgent need to write up Mangawahu and Maungakiekie - two brief but significant archaeological investigations (1979, 1981).
- c) In part of this as ongoing project - will take major research to do properly.

TITLE: Archaeological investigations at Pauatahanui

PROJECT LEADER: R.A. Sheppard

PROJECT: To determine the role of the Pauatahanui Inlet in the prehistoric settlement pattern of the Porirua District.

OBJECTIVES:

Excavation, analysis, and dating of archaeological sites under threat of destruction from land development.

To determine the purpose of the sites and their relationship with other sites in the Porirua District.

METHODS:

Standard archaeological excavation methods for site investigation. Analysis of growth rings in shell fish to determine the season of occupation. Analysis of seeds, charcoals, and landsnails for site environment. Analysis of shells and animal bones for determining the purpose of the sites. Radiocarbon dating for correlation with other sites in the Porirua District.

INTERIM RESULTS:

No structural remains were found associated with the sites.

The sites were probably seasonally occupied, during autumn and winter.

The environment of the sites appears to have been forested with localised clearings.

The sites appear to have been occupied for the purpose of exploiting forest and possibly grassland resources, including rat trapping and butchering.

The sites were occupied about 400 to 500 years ago.

INTERIM CONCLUSIONS:

The shores of the Pauatahanui Inlet appear to have been used as a giant larder, possibly for people who lived outside the inlet, either around the outer Porirua Harbour or on the outer Cook Strait coast.

TITLE: Motiti Island site survey

PROJECT LEADER: B.G. McFadgen

PROJECT: An archaeological site survey of Motiti Island was carried out as a basis for site protection.

OBJECTIVES:

To locate, record, and where appropriate map, archaeological sites on Motiti Island, Bay of Plenty.

METHODS:

Site survey was carried out on foot. Mapping was by pace and compass either to check dimensions and features of sites mapped from aerial photographs, or to completely map sites not visible on aerial photographs.

INTERIM RESULTS:

34 sites were recorded, including 23 pa sites, 1 pit site and one petroglyph site. All visible pa sites were mapped. A draft report is being edited.

INTERIM CONCLUSIONS:

Provided there is no change in land use, sites on Motiti Island are reasonably well protected.

PROJECT NO:

TITLE: An archaeological site survey of Tauranga County.

PROJECT LEADER: B.G. McFadgen

PROJECT: An archaeological site survey of Tauranga County was carried out and selected sites were excavated.

OBJECTIVES:

- a) Recording of all visible archaeological sites.
- b) Production of Historic Places inventory.
- c) Excavation of selected sites.
- d) Publication of an account of the prehistory of Tauranga
- e) Protection of archaeological sites.

METHODS:

Site recording was carried out on foot by University students employed under work schemes and by volunteers. Results were entered into a computerised data base developed for the project and used in the computerised production of the inventory of Historic Places.

Excavations were carried out under the provisions of the Historic Places Act 1980 using earthmoving equipment, volunteer labour, and electronic recording techniques.

For purposes of site protection, site locations were made--known to appropriate landowners, developers, and local authorities.

Sites were registered under the provisions of the Historic Places Act 1980, and heritage covenants have been negotiated.

INTERIM RESULTS:

Some 5000 archaeological sites were recorded including 449 pa sites.

An historic places inventory with maps showing site locations has been produced and sent out to local authorities and other appropriate organisations.

INTERIM CONCLUSIONS:

Archaeological remains seen on the ground give little indication of the type or scale of site that may exist, and the absence of visible remains is not an indication that no site exists.

Site registration is not very effective for protecting sites

For effective site protection and management, frequent visits by an archaeologist are needed.

TITLE Archaeological Investigations at Roto-o-Rangi Redoubt

PROJECT LEADER: B.G. McFadgen

PROJECT: Archaeological investigation of land abutting Roto-o-rangi redoubt in the Waikato following the issuing of an authority to Waipa County Council for the erection of a water reservoir and construction of an access road. The redoubt was understood to have been constructed within a former Maori pa inferred from a scarp and terrace around the south side of the hill on which the redoubt stood.

OBJECTIVES:

To recover information relating to the redoubt and Maori pa.

METHODS:

Earthmoving machinery was used to examine the site stratigraphy exposed in pipe trenches, and to clear topsoil from the proposed roadway and reservoir site.

FINAL RESULTS:

Archaeological remains found included a hut floor, pit, two charcoally deposits, seven postholes, and a mixed soil was possibly an old garden. All artifacts were of European origin and included bits of china, bottle glass, and wire.

FINAL CONCLUSIONS:

No clear evidence of Maori occupation was found.

The hut floor is possibly late 19th century and may date from the time of the redoubt. The age of the other features is unknown but they too are probably of similar age.

The scarp around the south side of the hill is unlikely to be from a former, prehistoric fortification and is probably of European origin.

TITLE: Archaeology at Butler Point, Mangonui.

PROJECT LEADER: Susan Bulmer

PROJECT: Archaeological site survey and excavations at Butler Point. This historically important property is owned by the Ferguson family who intend to open it to groups of visitors.

OBJECTIVES:

- a) To record and map surface evidence of prehistoric and early historic settlement.
- b) To excavate a small well-preserved pa, situated within a relatively undisturbed archaeological landscape.
- c) To investigate a range of other site types on the property.
- d) To collate historical and archaeological information for both scientific publication and for presentation to the public.

METHODS:

- a) Historical research.
- b) Field survey of the property. Correlation of the acquired data with other recorded archaeological evidence in Mangonui Harbour region, and with information from the owners and local residents.
- c) Excavation of selected sites using voluntary labour -initially the Pa and its immediate surroundings. Two short periods of investigation already undertaken in 1987 and 1988. Further work envisaged in the near future.

INTERIM RESULTS:

- a) The survey defined a rich variety of site types including pa, groups of terraces and stratified midden.
- b) A detailed plane-table map of the pa completed.
- c) Although no oral traditions concerning the pa have been discovered, excavation revealed that it was still occupied during the early historic period.
- d) The interior contains evidence of structures and numerous artefacts but no sign of food preparation or consumption. In contrast areas outside the defences contain dense midden and numerous hangi. Stratigraphy indicates more than one period of occupation.

INTERIM CONCLUSIONS:

In combination, survey data, artefact collections and historical records suggest intensive occupation of the area, which may encompass a time sequence from the archaic through to the early historic period.

Previous excavations north of the Bay of Islands have concentrated on archaic midden sites. The Ferguson's pa is small and could be fully excavated to provide valuable information on later stages of the region's prehistory and proto-history. Stratified undefended sites in the area will almost certainly contain earlier evidence.

Initial investigations confirm that this is an archaeologically important requires a continuing programme of work.

TITLE: Archaeology at the Wiri Oil Terminal Site (Matukurua fields)

PROJECT LEADER: S Bulmer

PROJECT: Archaeological investigation of 20 ha of archaeological stonefield sites at the Wiri Oil Terminal Site. Part of a larger investigation into Matukurua fields.

OBJECTIVES:

- a) Environmental history
- b) Settlement evidence
- c) Gardens: land system and selected features.

METHODS:

- a) Detailed field mapping 1982.
- b) Fieldwork in two stages 1982-3.
- c) Reports written 1983 -present. Everyone but one done 1986.

INTERIM RESULTS:

- a) Reports nearly completed, available only in Xerox form. To be produced in 4 volumes, 1-3 almost ready to go.
- b) Preliminary report 1983.
- c) Conference paper 1984 Garden summary, 1987 Settlement summary.
- d) S Bulmer working on Volume 1 revision - final drafts being typed.

INTERIM CONCLUSIONS:

- a) Distinct form of settlement not previously excavated.
- b) Garden mounts, garden terraces, use of sink holes: Broad spectrum garden including swamp edge terraces.
- c) Boundary system recognised by Sullivan 1972
- d) Variety of ecological zones in fields -varying archaeological features according to ecology.
- e) Long-term survival of forest - to 17th century or later.

TITLE: Archaeology at the Wiri Railway Site

PROJECT LEADER: David Veart

PROJECT: Investigation of 20 ha of Wiri fields to be quarried. Part of general investigation of field sites at Matukurua. (Next to Wiri Oil Terminal Site and Wiri Mountain).

OBJECTIVES:

- a) To contribute to understanding volcanic field gardens and settlement.
- b) To 'rescue' key evidence from a threatened landscape.
- c) To investigate selected features, including possible house terraces, garden mounds and a 1 ha plateau with habitation features in mound gardens.
- d) To obtain evidence of micro climate and soil management in mound gardens.

METHODS:

- a) Detailed mapping and recording of archaeological features.
- b) Excavation of selected settlement and garden features.
- c) Experimental study of mound garden.

INTERIM RESULTS:

- a) Survey report on field evidence 1985.
- b) Interim report -John Coster -State 1 excavation 1986.
- c) Draft report in prep. - David Veart on leave 18 months. Now (May 1988) returned to work half-time -draft half done.
- d) Experimental plot -12 months. John Coster's work suspended because of responsibilities to Dept in restructuring. Conference paper in draft (with S Bulmer) for Archaeometry Conference, August 1988, Adelaide.

INTERIM CONCLUSIONS:

- a) Evidence of garden methods in much greater detail - 2 sample gardens, 1 modified sinkhole, 1 mound garden.
- b) Plateau-settlement with houses one end and cooking at other, divided by wall for central area.

PROJECT NO: S8010/241
CORPORATE OBJECTIVE NO: 3

TITLE: Waikato Archaeology Regional Overview; Assessment and
Priorities

PROJECT LEADER: Neville Ritchie

PROJECT: This project is a familiarisation and resource management
exercise.

OBJECTIVES:

The aims of this project are to review the archaeological situation in
the Waikato region with a view to developing systematic management and
research programmes. The project will define the nature of the resource,
deficiencies in survey coverage and site recordation, and management and
research priorities.

METHODS:

Literature review, site and topography familiarisation, discussions with
relevant personnel, and report compilation.

INTERIM RESULTS:

The last 9 months have been a steady learning and familiarisation curve
with regard to Waikato sites, their management problems and considering
future avenues of research. 'Waikato Historic Resource Conservation
Strategy' document has not been completed yet.

INTERIM CONCLUSIONS:

- a) The archaeological resource in the Waikato region is rich and
varied. Farming operations and mining are the greatest threats.
- b) Much of the DOC estate in the Waikato region has not been surveyed
for archaeological sites. As inventory is a basic management tool,
surveys need to be planned and prioritised.
- c) The absence of early Maori sites along the western coastal margin
of the region needs further investigation.
- d) Many of the Land War sites offer excellent interpretation
opportunities which should be developed.

TITLE: Archaeology and History of the Ohaupo Redoubt

PROJECT LEADER: Neville Ritchie

PROJECT: The Ohaupo redoubt site was excavated, under an excavation - only contract, by Morgan Leatherby Associates in July 1986. The excavated material was in the Te Awamutu Museum until October 1987 when it was transferred to the DOC Waikato region workshop.

OBJECTIVES:

The objective is to analyse the materials, produce a combined archaeological/historical report, and relate findings to those from other Land War site excavations.

METHODS:

Artefactual and faunal analysis, historical and comparative research.

INTERIM RESULT:

Some background historical research has been undertaken, resulting from management work on other Land War sites.

TITLE: Archaeology for Katherine Mansfield Birthplace Society

PROJECT LEADER: Kevin Jones

OBJECTIVES:

- a) To provide well documented artefacts for display in the proposed house museum.
- b) To assist in the interpretation of the history of changes in the structure, fittings and surface decoration of the house.

METHODS:

Archaeological investigations of yard, drive, and under-house structures.

INTERIM RESULTS:

- a) A range of artefacts generally pre-dating the construction of the house have been obtained.
- b) Projects or interpretation are good.
- c) Some fittings and surface decoration especially in the original, demolished service areas of the house can be established.

INTERIM CONCLUSIONS:

- a) Archaeological techniques can supply a useful source of interpretation in remaking historic structures, although the need to work in a highly compressed historical time-scale is a challenge to archaeological techniques.
- b) Establishment of a site museum is possible.

RECOMMENDATIONS:

Ongoing monitoring of the peak re-construction activity April-November 1988 is needed.

TITLE: Archaeology at Pompallier House

PROJECT LEADER: Joan Maingay

PROJECT: An archaeological investigation of a 19th century tannery at Pompallier House, Russell. Previously little was known concerning this period of the building's occupation. Archaeological research can offer an important new dimension to the history and presentation of the property.

OBJECTIVES:

- a) To discover the methods and materials used in a 19th century colonial tannery.
- b) To conserve structures, organic material and artefacts for public display.
- c) To extend present knowledge concerning the history of the property, and its relationship with the wider Russell community.

METHODS:

- a) Excavation of structures at the rear of Pompallier House.
- b) Historical research into early methods of tanning.
- c) Conservation of artefacts and organic material
- d) Archaeological monitoring of drainage work.

INTERIM RESULTS:

- a) The first stage of excavation confirmed that the property was used as a tannery in the mid 19th century. Two tanning pits were defined at the rear of the building and organic material retrieved from them.
- b) Test pitting has revealed evidence of further pits and associated structures within the at the back of the house.
- c) Recent drainage trenches indicate that virtually the whole of the property contains subsurface archaeological evidence.

INTERIM CONCLUSIONS:

Only a small part of the tannery has been excavated. Further investigations are necessary to define the extent of the industry and determine the range of processes employed. This early industrial site is an essential aspect of Pompallier House history and of considerable significance within the regional context.

TITLE: Ecology and history of a biologically and culturally significant landscape.

PROJECT LEADER: Geoff Park

PROJECT: The ecology, history and conservation of the natural landscape of the coastal floodplains, dominated by kahikatea and harakeke, and the interaction of people with them.

The project is defined by the two facts:

- a) The forests that once clothed the coastal floodplains epitomise the biological diversity and antiquity of the NZ lowland forests,
- b) The natural landscape that has perhaps been the most useful to Maoris and European society is today the most poorly conserved.

OBJECTIVES:

- a) To examine the evidence from archival and oral sources concerning the changing European perception of these landscapes; to incorporate some account of the Maori perception.
- b) To relate this evidence to the places that have a considerable historic record but where the natural landscape has been totally transformed.
- c) To relate this evidence to the direct locational evidence from four sites where these natural landscapes are still extant, albeit in a remnant state.
- d) To develop a conceptual base for a re-appraisal of the conservation status of these particular natural landscapes, on the basis of their cultural and historical significance to the national estate.
- e) To prepare a book on the research results.

METHODS:

- a) Archival: A great range of archives (public records, diaries, newspapers, accounts, etc) from six localities have been examined and "filtered" for patterns of perception and attitude to the land.

- b) Oral: Approx 50 people, mainly elderly, who have "known" these localities have been interviewed.
- c) Field: The land has been examined at these localities (vegetation, archaeology).
- d) Integration: 1, 2 and 3 have been integrated, as research proceeded.
- e) General: A "national" historical perspective on these landscapes has been sought from archival sources.

INTERIM RESULTS:

- a) The great majority of the research is completed. Writing is well-advanced.
- b) For an understanding of these natural landscapes perhaps the most significant of any, conservation research needs to seriously examine their history. The results show the extent to which these landscapes were not only widespread in lowland NZ but the extent of their significance to the economic and cultural development of Maori, and European society.
- c) Because their disappearance coincided with the birth of nature conservation as we know it, conservation policy has always diminished these landscapes as marginal, remnant and of little consequence. This approach needs to be re-examined.

INTERIM CONCLUSIONS:

- a) Because of the deep cultural and historical significance of these particular landscapes, they have a special status in the conservation of the national estate.
- b) Nationally, regionally and locally the conservation status and management of remnant kahikatea and harakeke coastal floodplain landscapes needs to be carefully re-examined by DOC (inventory, management planning).
- c) There is a need to integrate the biological and cultural conservation requirements of these landscapes, based soundly on their history and in accordance with the Treaty of Waitangi.
- d) May be a need for a special national inventory, similar to the Wetlands Inventory, to complement that and the PNA surveys. It needs to be undertaken by this Directorate working with the regions and districts.

PROGRAMME 90 : INTERNATIONAL SCIENCE

- 10 Pacific Conservation
- 20 Antarctic Conservation
- 30 Marine Resources Conservation
- 40 Environmental
- 50 International Liaison

TITLE: Chapters on Ice for Two Antarctic Books

PROJECT LEADER: J R Keys

PROJECT: A chapter titled 'The Ice Forms' has been written for a New Zealand text on the Ross Sea region, and a chapter titled 'Ice' has been written for an Elsevier book on the Antarctic Pacific Ocean.

OBJECTIVES:

- a) Describe the ice forms in and around Ross Sea for a general readership.
- b) Complete a chapter with scientific references for a multidisciplinary audience describing ice and its significance in the Pacific sector of the Antarctic.

METHODS:

- a) Finish literature surveys and write the chapters basing 'The Ice Forms' on a simplified version of 'Ice'.
- b) Incorporate latest research findings from the Iceberg Project.

INTERIM RESULTS:

Chapters have been written and referees' comments answered.

INTERIM CONCLUSIONS:

These books will present accounts of our present understanding of ice and its significance (e.g. in terms of global climatic or regional ecological effects) in two parts of the Antarctic which have special significance to New Zealand.

TITLE: Antarctic conservation -Science policy and liaison

PROJECT LEADER: J R. Keys

PROJECT: Development of Antarctic conservation policy; liaison with environmental groups; minerals regime negotiations; links with national and international agencies.

OBJECTIVES:

To contribute to meeting the departmental responsibilities for promoting Antarctic conservation

METHODS:

- a) Establish links with Ministry of Foreign Affairs, DSIR, Ross Dependency Research Committee and components of the Antarctic Treaty system including CCAMLR and SCAR.
- b) Establish working relationships including terms of reference for liaison with environmental groups and other non governmental organisations.
- c) Prepare and circulate drafts of an interim departmental policy on Antarctic conservation.

INTERIM RESULTS:

- a) Liaison and links have been established within DOC, with including IUCN, and with government agencies.
- b) Considerable effort has been put into participation and reporting at meetings of the Consultative Parties, mainly concerning the mineral negotiations.
- c) Successive drafts of a policy paper have been circulated prior to the release of the department's Antarctic policy

INTERIM CONCLUSIONS:

- a) Antarctic conservation policy is small but important and a valuable part of the department's activities which has practical and strategic benefits.
- b) A large amount of consultation and liaison have occurred both within and outside the department but more is required.
- c) The minerals negotiations demand considerable time but will be completed by June 1988.

PROJECT NO: S9020/24
CORPORATE OBJECTIVE NO: 19

TITLE: Antarctica -scientific policy and liaison: IUCN Antarctic Programme

PROJECT LEADER: P Dingwall

PROJECT: Development of IUCN Conservation Strategy for the Antarctic.

OBJECTIVES:

To provide scientific expertise in development of a strategy for long-term conservation of environment and natural resources in the Antarctic.

METHODS:

Contribute written submissions to drafts, collaboration and liaison with NZ Antarctic community within and outside the department.

INTERIM RESULTS:

Draft IUCN/SCAR Plan for Long-term Conservation in the Antarctic published in 1986, and was comprehensively reviewed at IUCN/CNPPA Working Session, Wairakei August 1987. Further development of the programme occurred at Antarctic Workshop convened during IUCN General Assembly, Costa Rica, February 1988, which was chaired by P Dingwall.

INTERIM CONCLUSIONS:

Principal product 1987/88 was paper entitled "The Way Ahead -an action plan for development of an IUCN Antarctic Conservation strategy 1988-90" (P.R. Dingwall, Feb. 1988). This paper includes a recommended outline and timetable for strategy development, which has been agreed upon by the Director-General of IUCN. Further instructions are awaited, but substantial contribution is anticipated from NZ on protected areas and tourism matters.

TITLE: Conservation of historic huts and their contents, Ross Dependency region, Antarctica.

PROJECT LEADER: Neville Ritchie

PROJECT: To produce a detailed inventory of the historic provisions in the Heroic Era huts in the Ross Dependency.

OBJECTIVES:

The objectives of the exercise are to document the various products in the huts for both management and historical research purposes.

METHODS:

Container recording, photography, historical and comparative research.

INTERIM RESULTS:

Provision documentation was largely completed during the 1987-88 Antarctic season. Formatting options have been narrowed. Further historical research has also been undertaken but little progress has been made towards compilation of the proposed inventory manual.

The fieldwork and general management work undertaken on the Antarctic huts during the 1987-88 summer was completed successfully.

INTERIM CONCLUSION:

The proposed inventory which will detail all the provisions in the huts, their condition etc will be a useful management tool. Its production will generate new historical information.

TITLE: Foraging movements of Adelie Penguins in McMurdo Sound,
Antarctica.

PROJECT LEADER: R Sadleir

PROJECT: Field work was completed at the end of a three year study which was carried over by Sadleir in his move from Ecology Division, DSIR, in 1987. K.R. Lay and B.J. Karl, Ecology DSIR, assisted.

OBJECTIVES:

To determine the foraging locations at sea of Adelie penguins during the incubation and chick rearing stages. This information will be necessary in order to determine the impact of any human and industrial activity in McMurdo Sound on penguin populations on Ross Island.

METHODS:

Radio transmitters were attached to penguins and the birds were located by triangulation from two receivers with directional antennae. In 1987 these were located on Inclusion Hill (Ross Island) and Hansen Ridge (Victoria Land) giving a 75 km baseline.

INTERIM RESULTS:

During incubation in 1987 seventeen lines were successfully tracked. Most swam NE some 30 to 50 km from the rookery and then foraged for 3 to 7 days inside daily ranges of 10 radius. Afterwards birds swam rapidly north and out of maximum radio range of 150 km. They returned radially to the rookery from these distances. During the early foraging period birds were concentrated in discrete areas in the centre of McMurdo Sound due west of Beaufort Island.

INTERIM CONCLUSIONS:

When foraging during incubation penguins feed immediately in the central sound. They then swam to the north for the remainder of the period. The concentrated immediate feeding areas straddle ship routes down the sound. Any industrial spillage from ships would adversely affect birds during this period.

PUBLICATIONS

Davis, L.S., Ward, G.D. and Sadleir, R.M.F.S. (1988). Foraging by Adelie penguins during the incubation period. *Notornis* 35 : 15-23.

The project is in draft MS form and will be presented as a paper to the 1st International Conference on Penguins (Dunedin August 1988) and as a poster to the 5th Symposium on Antarctic Biology (Hobart, September 1988).

TITLE: Distribution and movement of Ross Sea icebergs as environmental hazards and indicators of the state of the Antarctic Ice Sheet

PROJECT LEADER: J R Keys

PROJECT: This project has been gathering information on the detection, distribution, size, source and movement of icebergs particularly in the western Ross Sea. This is being done because icebergs are hazards which will deter mining in Antarctica because iceberg production is the main way the ice sheet, which responds to climate change, loses mass.

OBJECTIVES:

- a) Determine the best means of detecting icebergs.
- b) Clarify iceberg distribution in Ross Sea, particularly along the west coast.
- c) Determine iceberg sources and movement patterns.
- d) Measure sizes, drafts and volumes of icebergs in fast sea ice.

METHODS:

- a) Oblique and aerial photography coupled with vertical photography and satellite imagery and some ground-based work on fast ice.
- b) Visual tracking of individual icebergs over time

INTERIM RESULTS:

More than 4000 icebergs have been detected by a variety of methods over a four year period, well over half in the 1987/88 season.

Over 30 icebergs have been tracked, some for 4 successive seasons.

Icebergs up to 160 kilometres long occur in the region and have drafts at least as deep as 300 metres, but the smaller icebergs are most numerous.

INTERIM CONCLUSIONS:

- a) Helicopter based vertical photography and SPOT imagery are most useful but oblique photos from a C-130 are most convenient.
- b) Iceberg populations are variable but are most numerous and hazardous near the Victoria Land coast.

- c) Icebergs come from local glaciers and the more distant Ross Ice Shelf and are driven mainly by regional scale currents. This has extended our knowledge of current patterns and potential pollutant pathways in Ross Sea and of how warming sea temperatures might affect Ross Ice Shelf.
- d) The median width of icebergs is 50-100 m.
- e) Sizes of freshly carved bergs and size distributions can be used to derive iceberg volumes which give information about the rate of wastage of Ross ice Shelf.

TITLE: External Scientific Liaison: NZ Committee of IUCN Members

PROJECT LEADER: P Dingwall

PROJECT: Participation in meetings and related business of the Committee as deputy departmental representative and member of Commission on National Parks and Protected Areas.

OBJECTIVES:

To contribute scientific information to the work of IUCN in NZ and elsewhere and provide departmental link with the Committee.

METHODS:

Attendance at meetings; assistance with agenda preparations; reviews of agenda papers, introduction of departmental submissions, and follow-up action.

INTERIM RESULTS:

Five regular meetings attended 1987/88.

Major items of business requiring input were:

- a) Protection of oceanic islands from rodents - management guidelines.
- b) Environmental guidelines for World Bank Governors.
- c) Long-term conservation in the Antarctic.
- d) Revision of the World Conservation Strategy.
- e) Nature conservation in the South Pacific.

INTERIM CONCLUSIONS:

Department is NZ State Member of IUCN and effective servicing of Committee and contribution to its work, especially input of scientific expertise, are important responsibilities which should be maintained.

TITLE: External Scientific Liaison : IUCN Commission and General

PROJECT LEADER: P Dingwall

PROJECT:

Conduct role of IUCN on National Parks and Protected Areas, Vice-chairman for Antarctic Realm.

OBJECTIVES: To participate effectively in the work of the Commission in the NZ, Subantarctic and Antarctic regions, and report to IUCN.

METHODS:

Prepare position papers, policies, reviews. Arrange meetings and contribute to them.

INTERIM RESULTS: Principal activity in 1987/88 was arranging and hosting 29th Working Session of IUCN, held at Wairakei in August 1987. Session provided a comprehensive review of protected area developments in the Realm and was attended by 66 professionals from 7 countries. Major items discussed were:

- a) Review of NZ protected areas network
- b) Future developments in NZ protected areas.
- c) Marine protection in NZ
- d) Conservation of Antarctica, the Southern Ocean and Subantarctic islands.
- e) Developments in protected area system for South Pacific.

RECOMMENDATIONS:

Various follow-up activities have occurred and proceedings published by IUCN as: "Conserving the Natural Heritage of the Antarctic Realm", P.R. Dingwall (ed), 222 pp.

TITLE: External Scientific Liaison : NZ Man and the Biosphere Committee, UNESCO.

PROJECT LEADER: P Dingwall

PROJECT: Chair and participant in meetings of Committee

OBJECTIVES:

To provide for an effective NZ contribution to work of UNESCO's Man and the Biosphere Programme, and maintain links internationally.

METHODS:

Arrange, chair and contribute to meetings.

INTERIM RESULTS:

Three meetings held 1987/88.

Major items discussed:

- a) Contribution to 24th Session of Unesco's General Conference in November 1987.
- b) Participation by Committee member at Indonesian hosted Regional Seminar on Environmental Education at University level, including preparation of NZ review paper.
- c) Continued development of a proposed NZ Biosphere Reserve.

INTERIM CONCLUSIONS:

Major outputs included:

- a) Draft publication "Sound Science" recording proceedings of hui held at Waikawa Marae, to discuss regional resource use integration for Marlborough Sounds.
- b) Publication of paper "Environmental education in New Zealand Universities" (A.S. Gunn, July 1987).
- c) Preparations for contribution to UNESCO meeting in Wetlands, Hungary, June 1988, (P. Simpson) and to Environmental Monitoring Seminar, Dunedin, May 1988, (P. Dingwall).

APPENDIX 1
CORPORATE OBJECTIVES .

APPENDIX I
CORPORATE OBJECTIVES

1. To survey ecological districts under the PNAP, evaluate survey recommendations and implement those that are appropriate after wide consultation.
2. To manage all plants and animals which have the potential to adversely affect lands managed by the Department or other natural or historical resources or the property of other persons.
3. To identify and conserve historic resources and provide for their enjoyment by the public.
4. To raise public awareness of the natural and historic resource heritage and the role of the Department and to actively promote support for the commitment to conservation and related initiatives.
5. To improve the understanding of, and encourage the implementation of the principles of the Treaty of Waitangi, as they relate to conservation advocacy and management.
6. To develop and maintain effective relations with conservation interest groups and quangos, and increase the level of public involvement with the Department.
7. To formulate integrated management plans and overall strategy documents which cover multiple conservation objectives, to safeguard intrinsic ecological and landscape values.
8. To manage endangered, vulnerable, rare and other protected species of plants and animals and their ecosystems to safeguard their genetic characteristics and ensure their long term viability.

9. To conserve the natural and historic resources, recreation values, of land that is subject to pastoral lease and pastoral occupation license under the Land Act.
10. To manage commercial recreation and tourism on lands managed by the Department.
11. To manage public recreational use of land administered by the Department.
12. To investigate specific conservation issues and advocate positions, plans and programmes that advance conservation the natural and historic resource heritage.
13. To provide for the management of freshwater fish, game birds and harvested fauna and their habitats.
14. To manage marine reserves and establish a comprehensive network of marine protected areas.
15. To understand the distribution, structure and processes of natural and modified ecosystems, the effects of human impact on them, and to develop management recommendations from such understanding.
16. To provide an efficient and effective fire control system for fire prevention and suppression on all land administered by the Department.
17. To establish a coastal resource inventory and to manage the coastal, marine and freshwater environments to maintain, enhance or restore their natural character and qualities.
18. To develop ways by which natural resources traditionally used by Maori can be managed to sustain those uses without detriment to the resource or its associated habitats.

19. To develop and maintain relations which, meet obligations and contribution to international or foreign agencies or conventions involved with conservation.
20. To protect marine mammals and their habitats.
21. To assess the social implications of conservation initiatives, and the likely conservation consequences of socio-economic trends.
22. To develop and market on a commercial basis goods and services that promote conservation.
23. To manage sensitively the demands placed on the land managed by the Department for commodities.
24. To manage water and soil on the land administered by the Department, and to advocate the conservation of these values elsewhere.
25. Corporate Overheads
26. To promote conservation in the planning processes of other agencies and improve planning methods under all resource statutes.