

4. Species Biology and Ecology

The kakapo is nocturnal and cryptic, so little is known of many aspects of its biology. The following brief account is intended as a background only, and more information can be found in the references.

Kakapo are flightless parrots. They live for decades (it's not known exactly how long) and breed infrequently. They are stocky; adult males weigh up to 3.6 kg naturally, and adult females considerably less (up to 1.6 kg). Their feathers are varied shades of green and yellow and are very soft (as they are not required to support flight). The birds' faces are owl-like, framed by stiff whiskery feathers.

Kakapo can walk several kilometres in one night and are good tree climbers. Males (in the non-breeding season) have a home range of 15-30 ha, compared with the females' 35-50 ha. These ranges can overlap considerably, and it is not unknown for birds to move temporarily out of their usual range.

REPRODUCTION

Kakapo are 'lek' breeders: in late spring and early summer, all or some of the sexually mature males clear their track and bowl systems, within sound but not generally within sight of each other. The track and bowl systems consist of tracks leading to shallow depressions in the soil (bowls), nearly always on a prominent place, where the males try to attract females by calling. The males' low-frequency booming can go on every night for up to four months, and the sound can travel up to five kilometres. Booming is generally alternated with chinging, a higher pitched and more directional sound. The kakapo is the only flightless bird, the only New Zealand bird, and the only parrot in which lek behaviour has been observed.

This is the males' only contribution to breeding.

Kakapo breed once every two to five years. Even when there is a breeding season, not every female lays. The breeding cycle differs between locations, and the stimuli for breeding are not known.

Up to four eggs are incubated, entirely by the female, for about 30 days. Chicks are also raised by the female, who leaves the helpless chicks for several hours each night while she goes away to feed. The chicks stay in or near the nest for about three months and depend on the female for food for at least three months after that. They then establish a home range of their own, up to several kilometres away.

It isn't clear exactly when young birds reach sexual maturity. Male booming is one sign, and two males attempted booming (of a sort) at four years. The youngest female known to lay was nine years old.

Nesting has been detected for six summers from 1985: 1985, 1990, 1991, 1992, 1993, and 1995. Twenty fertile eggs were laid, but only five young fledged. Three (one female and two males) survived. Since 1985 only 11 of the 19 known



Female at feeding hopper,
Little Barrier Island, 1993.
Photo: B. McKay

females are known to have laid eggs; three laid infertile clutches only. In short, recovery of the kakapo as a species now may depend on the breeding efforts of eight females - six of unknown (but considerable) age, one younger female, and the subadult Hoki.

NUTRITION

The natural diet of kakapo in their former range has been studied by analysis of droppings from Stewart Island and Fiordland birds, but this has not provided much information about basic nutrition. Kakapo are herbivores, eating a variety of foods - roots, bark, stems, leaves, flowers, fruit, rhizomes, and seeds. There may be a connection between breeding and heavy fruiting, particularly of such favoured foods as rimu (*Dacrydium cupressinum*).

Supplementary feeding of birds on islands has resulted in a weight increase and seems correlated to an increase in breeding activity, but results are inconclusive. Further research is needed into the components of the birds' diets and into how their diet can or should be adjusted.

HABITAT

Kakapo have been recorded from a range of habitats (but no alpine ones). Very little research has been done on the distribution of fossil and subfossil kakapo remains, but it seems likely that the birds inhabited much of New Zealand. Habitats where kakapo survive today may not be those optimal for breeding but simply those with fewest predators. Identifying future habitat must consider the availability of natural food which could facilitate breeding, as well as safety from predation.

PREDATORS AND DISEASE

While forest clearance has destroyed much kakapo habitat, the great speed with which the birds have disappeared from even large untouched forest blocks indicates that predation, rather than habitat loss, is mainly responsible. Richard Henry's first attempt to save kakapo was thwarted by stoats, and the Stewart Island population was shifted as a response to predation of adults by feral cats. Rats invade nests, and the eggs and chicks are open to attack during the hours when the female is away looking for food.

Predator-free offshore islands provide the only way of protecting kakapo from predators in the foreseeable future, but more islands suitable for kakapo are needed.

The present kakapo islands are not without predator threats. There are kiore on both Little Barrier and Codfish islands, and stoats occasionally swim to Maud. Kiore are a serious threat to kakapo eggs and chicks and also compete with kakapo for food, while stoats eat adult kakapo as well as chicks and eggs. Effective ways of eliminating predators are essential to the species' survival.

Little is known of the diseases that kakapo suffer, but it is likely that they have been exposed to several new ones since the arrival of Europeans, poultry, cage birds and introduced European birds.

Three-month old fledglings,
1992. Photo: Auckland Zoo



5. Kakapo Recovery Planning

The crucial need for more knowledge was specifically pointed out in the first recovery plan: very little was known about kakapo feeding, breeding, and behaviour in general. It was clear that without further research and further information, recovery planning would continue to depend upon sparse information and the intuitive response of skilled people.

The first recovery plan (Powlesland, 1989) set out research and management priorities for 1989-94. Immediately after the plan's production, a workshop including everyone involved in kakapo management and research suggested changes to some parts of the plan but endorsed most of it. To advise the Department, a Kakapo Recovery Group, comprised of experts from inside and outside of the Department, was set up. Towards the end of 1994, the first recovery programme was reviewed.

The review, prepared by Imboden, Jones and Atkinson at the end of 1994, suggested substantial restructuring of the kakapo management programme and recommended new research and management directions. The Department of Conservation adopted most of these recommendations, consolidating kakapo management into a central National Kakapo Team. The team included the Kakapo Management Group (manager, senior scientist, and senior technical officer), who report directly to the Deputy Director-General of the Department, and the Kakapo Programme Officers, who work on the kakapo islands. This was a substantial change, as kakapo management had previously been run from within the Department's regional structure. The new arrangement integrates the Department's kakapo management and research work throughout New Zealand. The Kakapo Recovery Group was disbanded.

The management and scientific activities of the National Kakapo Team are scrutinised by the Kakapo Scientific and Technical Advisory Committee (KSTAC), made up of senior scientists and administrators. It is through KSTAC that the national team develops work plans and priorities for action within a given period.

One of the first tasks of the Kakapo Management Group was to prepare a new recovery plan, and another workshop, in August 1995, was convened. The 32 participants of this workshop considered all the recommendations of the Imboden, Jones and Atkinson report. Most of the recommendations were endorsed, a few were changed, and some were rejected; an outline of the 1996-2005 recovery plan was prepared.

6. Kakapo Recovery Plan 1996-2005

This document is intended to guide the National Kakapo Team during the next ten years. It has been written for the survival of the kakapo and is based on the experience and skills of a wider team, who participated in the 1995 workshop. The plan identifies further research needs and provides an overall framework for future management. The plan will be updated in response to significant new information.

Detailed research and work plans and operational procedures are not included in this printed ten-year document, *Kakapo Recovery Plan 1996-2005*, as they are frequently updated to reflect changes in technology and reworking of annual planning rounds. They will be included in a frequently-revised document collection, distributed to those working with the project and kept available for examination at Department of Conservation regional libraries.

The various options for recovery are not presented again here. They were extensively reviewed in the external review of the kakapo programme (Imboden, Jones and Atkinson, 1995). The directions of this plan are the most suitable options identified by that review.

The kakapo is among the slowest breeding birds on earth, and any recovery planning must keep this in mind: results are unlikely to be instantly visible, as response (by the birds) will be slow. The primary thrust of kakapo management is to maintain all birds in a healthy state, minimising mortality. This is particularly focused on maximising survival of chicks, so that they can be recruited into the breeding population. Priority is being given to research aimed at increasing breeding frequency.



Female standing at nest
entrance, Stewart Island, 1981.
Photo: C.R. Veitch

7. Current Recovery Strategy

The Department of Conservation's vision of the kakapo recovery programme is:

To establish at least one viable, self-sustaining, unmanaged population of kakapo as a functional component of the ecosystem in a protected habitat, and to establish two or more other populations which may require ongoing management.

Working from the vision, going from general planning to specific doing, leads to goals for the planning period - what ought to be done. We will have made significant progress toward this vision if over the next ten years we can meet the following goals:

- GOAL 1: To increase breeding frequency above existing levels, such that: currently sexually active birds breed more often, and/or currently non-sexually active birds start to breed.
- GOAL 2: To increase productivity of nesting attempts, such that: eight or more female kakapo are recruited to the population by the year 2005, and that there are at least 24 breeding attempts during this time.
- GOAL 3: To determine why kakapo breed infrequently.

From goals come objectives - how this should be done. The objectives listed below are not hierarchical; some can be done in parallel. They show in detail how we plan to achieve our goals.

Objective 1: Maximise egg and chick survival by minimising mortality from predation, starvation, disease, parasites, inadequate hygiene, natural events (e.g., flooding) and poor parenting.

- 1.1 Ensure consistent and effective management:
 - develop and update 'operational' plans, including criteria and protocols, for kakapo breeding, and keep adequate records of this.
- 1.2 Minimise risk of rat predation:
 - carry out research and trials to increase the effectiveness of rodent control around kakapo nests
 - carry out rodent control around all kakapo nests.
- 1.3 Monitor all nests:
 - use remote video cameras and other appropriate technology
 - intervene if necessary to remove eggs and chicks in the event of serious predator threats, starvation, or natural catastrophes such as flooding and predation.
- 1.4 Ensure nesting females receive adequate nutrition.
- 1.5 Collect information in case captive breeding is needed:
 - determine natural weight loss of eggs and incubation conditions in the nest
 - develop a standard growth curve for chicks
 - develop an artificial diet for chicks using an analogue species
 - train staff and provide facility for artificial rearing.

Objective 2: Maintain and increase breeding life of kakapo.

- 2.1 Establish physiological norms:
 - establish physiological norms for use in bird management and sampling
 - investigate gut morphology.
- 2.2 Develop handling protocols:
 - develop and maintain protocols for quarantine, disease, hygiene, specimen collection, and food handling
 - identify normal health parameters for parasite loads and incidence of disease
 - develop adult condition and moult indices
 - ensure field staff are trained in appropriate management and sampling techniques
 - carry out risk-benefit analysis before any disturbance to kakapo.
- 2.3 Manage male conflict/fighting to eliminate risk of serious injury or death, intervening if necessary.
- 2.4 Remove risk of predation:
 - promote the eradication of kiore from Little Barrier and Codfish Islands (see also objective 6.4)
 - continue stoat control programme to protect Maud Island.
- 2.5 Supplementary feeding:
 - Refine the supplementary diet to maximise breeding and productivity (see also objectives 1.4 and 4.2).

- 2.6 Develop methods of aging kakapo and determining breeding life span.
- 2.7 Investigate the potential for hormone therapy to extend breeding life, especially of females.
- 2.8 Determine past and present causes of adult mortality and take steps to eliminate avoidable causes of death:
 - develop technology for continual monitoring of kakapo movements
 - examine data on kakapo deaths.

Objective 3: Identify ways of increasing kakapo breeding frequency.

- 3.1 Increase knowledge of natural nutrition:
 - analyse known natural food items
 - monitor plant phenology, investigating links with kakapo breeding
 - conduct research on plant hormones and other possible environmental triggers which may initiate breeding
 - investigate effect of kiore on kakapo food supply.
- 3.2 Investigate artificial rearing (see also objective 1.5).
- 3.3 Refine and develop supplementary feeding techniques (see also objectives 1.4 and 2.4).

Objective 4: Determine where productivity is being lost.

- 4.1 Develop methods to assess the fertility of individual birds (see also objective 5.2):
 - identify birds involved in all matings, including previous matings (see also objective 5.1)
 - obtain sperm for investigation and evaluation of sperm viability
 - identify family trees and parentage (see also objective 5.1)
 - manipulate matings to ensure fertile birds mate with fertile birds.
- 4.2 Test effect of supplementary feeding on productivity (see also objectives 1.4 and 2.4).
- 4.3 Investigate possible effects of transmitters on fertility.
- 4.4 Determine causes of egg and chick mortality:
 - determine whether non-viable eggs are infertile or early embryo death.

Objective 5: Maintain genetic diversity.

- 5.1 Develop knowledge of genetic makeup of population:
 - collect blood, tissue and feather samples from every kakapo
 - develop safe blood and tissue collecting techniques
 - develop storage techniques for blood and tissue
 - develop and maintain a DNA database for all individuals
 - include preserved (museum) material in the DNA database
 - manipulate matings where necessary to achieve optimal genetic diversity
 - investigate feasibility of artificial insemination.

- 5.2 Develop techniques which will allow possible future use of artificial insemination:**
- develop effective sperm collection techniques
 - develop sperm storage capability
 - collect sperm from all male birds, especially the remaining Fiordland male
 - increase knowledge of courtship and mating behaviour by monitoring and observation at track and bowl systems
 - develop artificial insemination techniques.

Objective 6: Work with conservancies to manage islands for kakapo.

- 6.1 Liaise with conservancies on island management issues.
- 6.2 Maintain close communication with conservancy staff involved in kakapo work.
- 6.3 Work with conservancies to identify possible new islands for kakapo.
- 6.4 Maintain an active involvement in proposals for kiore eradication on potential kakapo islands (see objective 2.3).

Objective 7: Increase public awareness of kakapo conservation.

- 7.1 Identify and liaise with groups and individuals involved in kakapo conservation.
- 7.2 Maintain close communication with the Minister, the media, and appropriate DoC officers.
- 7.3 Use volunteers where appropriate.

Objective 8: Develop contingency plans.

- 8.1 In advance, develop contingency plans for action to be taken when:
 - there is a threat to eggs or birds (e.g., rats or stoats observed at nest site,
 - female is absent from nest containing eggs or chicks at different stages of development,
 - there is lack of expected growth or development of birds,
 - there is danger from flooding, landslide or other natural disaster.

Objective 9: Collect, store and publish information on kakapo.

- 9.1 Encourage formal scientific publication of research results.
- 9.2 Develop database of all kakapo information (see also objective 3.1).
- 9.3 Conduct a population viability analysis.
- 9.4 Obtain and analyse information on home range and habitat quality, and relate this to breeding histories.
- 9.5 Obtain and analyse all existing nutrition and diet information, and relate this to breeding histories.
- 9.6 Produce and distribute an annual report.
- 9.7 Update the recovery plan as required.

8. Further Reading

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- Imboden, Christoph; Jones, Peter; and Atkinson, Ian. 1995. *Review of the Kakapo Recovery Programme: Report for the New Zealand Department of Conservation*. Unpublished report (January 1995). Department of Conservation, Wellington.
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- Molloy, Janice, and Davis, Alison. 1994 *Setting priorities for the conservation of New Zealand's threatened plants and animals*. Department of Conservation, Wellington. 2nd edn.
- Morris, Rod, and Smith, Hal. 1988. Kakapo, the old night parrot. Pp. 134-157 in Wild South: *Saving New Zealand's Endangered Birds*. Century Hutchinson, Auckland. [Revised edition, 1995]
- Poulton, Sarah. 1982. *Kakapo: A Bibliography*. New Zealand Wildlife Service, Wellington. [A full listing of unpublished reports and of scientific and general publications, including newspaper articles.
- Powlesland, Ralph. 1989. *Kakapo Recovery Plan: 1989-1994*. Department of Conservation, Wellington.
- A bibliography of post-1982 publications is in preparation.

Appendix 1

List of Working Documents

Note that this list represents the working document collection as at June, 1996. Material is replaced frequently (and irregularly) in order to keep research, technological and planning information up to date at all times. What you see here is not necessarily what you will get when examining the document collection.

1. BIRDS

National protocol for kakapo management

National protocol for kakapo breeding season

Protocol for the protection of kakapo eggs and nestlings from predation by kiore

Treatment and storage of dead kakapo

National protocol for design and fitting of radio transmitters to kakapo

Contingency options for kakapo nesting - Maud Island

Guidelines for monitoring kakapo on Codfish Island

Flow diagrams for disaster protocols

Nest list for kakapo

Veterinary list for kakapo

2. PEOPLE

Contact list: names, phones and addresses

Authority to catch, disturb and collect samples from absolutely protected wildlife

Authority to hold absolutely protected wildlife

Institutional permit to band birds

Authority to place cameras [&c] adjacent to breeding sites of absolutely protected wildlife

Authority to capture, handle and transfer eggs, chicks and adults of absolutely protected wildlife

Banding permit

[Kakapo-related matters only. General safety instructions, personnel information and visitor protocols are not included here.]

3. EQUIPMENT

Basic electronics notes for kakapo officers: maintenance and care

Instructions for running the scanner logger

[Kakapo-related equipment only. Instructions for general telecommunications gear, computers, video and camera equipment, and but equipment are not included here.]

4. PLANS

Kakapo research plan 1995-2005

Kakapo recovery plan 1996-2005 (in press)

National Kakapo Team Business Plan (1996-97 draft)

National Kakapo Team Business Plan (1995-96)

KSTAC Minutes (current)

Annual Report of Kakapo Management Group (current)

5. NOTES

[Assembled by island field staff, for their individual use.]