Conservation of kakerori (*Pomarea dimidiata*)

Report on a visit to Rarotonga, August/September 1999

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Summary

Since 1987, I have assisted the Cook Islands Conservation/Environment Service and, more recently, the Takitumu Conservation Area Project and the Avifauna Conservation Programme of the South Pacific Regional Environment Programme (SPREP) to plan and implement a recovery programme for the kakerori, a critically endangered forest bird endemic to Rarotonga. In 1989, the kakerori was one of the 10 rarest birds in the world, and classified as 'critically endangered' (Collar et al. 1994) with a population of just 29 birds. I calculated that there was a 50% chance of kakerori becoming extinct by 1998 unless nest predation by rats was significantly reduced. During each breeding season since 1989, rats have been poisoned in the 155 ha of forest occupied by kakerori (Robertson et al. 1998) and the effectiveness of this work has been measured by recording breeding productivity (Saul et al. 1998), and by undertaking an annual census the following spring (Robertson 1998, 1999).

In 1996, the 155 ha area of southern Rarotonga which is occupied by kakerori was adopted by SPREP as a Conservation Area within the South Pacific Biodiversity Conservation Programme (SPBCP). Management of the Kakerori Recovery Programme (KRP) was passed from the Cook Islands Environment Service to the Takitumu Conservation Area Project (TCAP). The aim of the project is to develop ecologically sustainable economic activities (e.g. ecotourism) to generate income for conservation management in the area and for the local landowners. The KRP provides valuable scientific and conservation management data which will enable a better understanding of the biological processes involved in the recovery of critically endangered birds. Because this is relevant to the management of other species in the South Pacific region, SPREP's Avifauna Conservation Programme has picked up some of the costs, including those of my annual visit to provide scientific advice to the KRP and the TCAP.

In 1999, I made a 3½ week visit to Rarotonga to provide scientific advice on the conservation management of kakerori and to help Ed Saul to train TCAP staff in various conservation management techniques. Between 13 August and 5 September 1999, I worked with Ed Saul and Mataiti Mataiti of the TCAP, and Greg Sherley (SPREP) to:

- Carry out a population census
- Colour-band as many young kakerori as possible
- Collect blood samples to see whether kakerori have blood parasites which could infect other bird species if kakerori are transferred to another island in the southern Cooks
- Plan the 1999/2000 field programme
- Liaise with the landowners who run the TCAP

During the August 1999 census (and updated with a few more recent sightings by Ed Saul) we counted 184 birds in the TCA, an increase of 13 birds (8%) over the previous year. The increase from 1998 to 1999 was modest, mainly due to poor recruitment of yearlings. Adult survival was again close to 90% (88.9%),

but from 59+ fledglings raised in the 1998/99 breeding season, only 32 yearlings were positively identified in August 1999, whereas from previous survivorship data we expected that there would have been 45–50 yearlings. A prolonged period of wind and rain in January–March 1999 may have accounted for some of these youngsters, although some may have dispersed from the TCA. We mist-netted and individually colour-banded 18 birds and recaptured one bird, bringing the number of colour-banded birds to 120 (65% of the population). We collected 18 blood smears from kakerori, 1 from an I'oi or Rarotonga starling (*Aplonis cinarescens*), and 9 from Mynas (*Acridotheres tristis*). These were studied by veterinary haematologists and found to contain no blood abnormalities or blood parasites.

I worked with Ed Saul to design the rat control programme for 1999, with the aim of maintaining the system started in 1998 which greatly reduced costs of labour and poison baits, reduced the use of poison baits, and gave adequate protection to nesting kakerori. The new programme started the poisoning a fortnight earlier than usual, and reduced the density of bait stations on the perimeter of the control area. This season, we showed that both ship rats and Pacific rats were present in the poisoned area at various stages during the poisoning season, and showed that spraying 'tropical formulation' Talon baits with coconut oil increased their palatability to rats.

I attended two meetings of the Takitumu Conservation Area Project Committee (landowners), one of which was also attended by Greg Sherley (Programme Officer Avifauna Conservation and Invasive Species, SPREP) and I'o Takeu-Lindsay (Director, Cook Islands Environment Service).

I recommend that the Department of Conservation and SPREP continue to be involved in this very successful conservation programme, which has not only helped to conserve the kakerori, but which can be used as a model for tackling similar conservation problems elsewhere in the Pacific. This project also provides a model for community involvement in the sustainable development of a conservation area, and much interest in the Pacific is focused on its success to date.

1. Background

In a review of the bird conservation problems in the South Pacific, commissioned by SPREP and the International Council for Bird Preservation in the early 1980s, Hay (1986) identified the kakerori, or Rarotonga flycatcher (*Pomarea dimidiata*), as one of the species most urgently in need of conservation management (Robertson et al. 1994). This small flycatcher, which is endemic to Rarotonga, was critically at risk of extinction.

As a result of a study between September 1987 and January 1988, Rod Hay and Hugh Robertson reported to the Cook Islands Conservation Service (CICS) and SPREP that ship rats were having a very detrimental effect on the breeding of kakerori, and that cats were likely to be predators of recently fledged juveniles and adult birds. The report provided a draft plan for the recovery of the kakerori, with recommendations on a cost-effective recovery programme and scientific study aimed at assessing the effectiveness of this work.

The draft recovery plan was adopted by the CICS and SPREP (Project PA 12) in July 1988, to be implemented by DSIR Ecology, the CICS and SPREP. Subsequently, both Hugh Robertson and Rod Hay shifted from DSIR to the New Zealand Department of Conservation. The Department has continued to provide some support to Hugh Robertson for supplying scientific advice to the Kakerori Recovery Programme and the Takitumu Conservation Area Project.

The original objectives of the Kakerori Recovery Plan were:

1. To monitor, on an annual basis, the dynamics of the kakerori population on Rarotonga.
2. To research, develop, and implement an effective predator (rat and feral cat) control programme; this would include an assessment of rat populations in relation to kakerori distribution.
3. To research, develop, and implement, where appropriate, a programme of managing the kakerori population by protecting nests, providing supplementary food, and as a last resort by translocation or captive breeding.
4. To describe the habitats used by kakerori, and determine the relationship between habitat features and the distribution of kakerori.
5. To develop, and implement a programme of public education, awareness and participation, where appropriate, in the kakerori conservation programme.
6. To encourage the protection of the kakerori, by creating a suitable reserve, and developing appropriate national and international policies regarding scientific collection or trade in kakerori, and the importation of wildlife (and hence potential diseases) into the Cook Islands.

Our 'unofficial' aim was to have over 100 birds by the year 2000.

The Kakerori Recovery Plan was updated in 1995 in a Cook Islands Environment Service document (Saul 1995). This re-affirmed the above aims, but expanded on aim (3) by promoting a feasibility study into the possibility of translocating kakerori to another island in the southern Cooks which is free of ship rats (e.g. Aitutaki or Atiu).

In 1996, SPREP adopted a joint proposal from the new Ministry of Works, Environment and Physical Planning of the Cook Islands government and the Takitumu Conservation Area Co-ordinating Committee (representatives of the three customary land-owning families involved) that a 155 ha area of the southern part of Rarotonga, which is the home of the kakerori, be adopted as a Conservation Area as part of the South Pacific Biodiversity Conservation Programme (SPBCP). The goal of the project on the Takitumu Conservation Area (TCA) is 'to conserve the Conservation Area's biodiversity for the benefit and enjoyment of present and future generations on Rarotonga'. More immediate objectives are:

1. To develop partnership arrangements between government, landowners, NGOs and others for effective management and sustainable use of biodiversity in the TCA.
2. To develop and implement management plans for the wise management and use of biodiversity with the TCA.
3. Raise public awareness about the importance of and means for conservation of biodiversity in the TCA.
4. Promote, implement and support sustainable economic activities by communities associated with the TCA.
5. Develop, as appropriate, a model for the implementation of Conservation Areas in other parts of Rarotonga and the Cook Islands.

The TCA project will be funded by the SPBCP for the 5 years to 2001, after which it is expected to be able to make its own way and survive without further funding from SPBCP. The main attraction of the TCA to international tourists is undoubtedly the kakerori and its management programme, but the area also hosts breeding populations of the other three species of native landbird and four of the six species of seabird on Rarotonga, a fruit-bat colony, and several rare shrubs and orchids. It seems logical that when the TCAP becomes self-supporting in 2001, the 20% of profits being returned to the Kakerori Recovery Programme will be spent on the actual rat-poisoning programme, rather than the scientific recording of bait take and other experiments aimed at reducing poison and labour costs. Likewise, the recording of kakerori nesting success (see Robertson et al. 1998) and the annual census of birds (the measures of the success of the rat-poisoning) are unlikely to be funded by the land-owners, despite their acknowledgement that these have been critical in developing the current management programme. At the Polynesian Avifauna Conservation Workshop held in Rarotonga in April 1999, the Kakerori Recovery Programme was identified as a flagship project in Polynesia, and it is now being used as a model for other similar threatened species projects in the region. Because the scientific work underpinning the recovery of the kakerori is of wider application than just the management of the TCAP, and it is currently a major cost to the TCAP, the Avifauna Conservation Programme of SPREP decided to fund the scientific work and training of TCAP staff in conservation management for a minimum of three years, separate from the funding line from the SPBCP of SPREP to the TCAP.

The kakerori recovery work funded by the Avifauna Conservation Programme is being done in close liaison with the TCAP, and will also report to the Cook

Islands Environment Service and work with them in developing any plans to transfer kakerori to other islands in the southern Cooks.

Ed Saul, formerly of the New Zealand Wildlife Service and DSIR, and more recently a conservation volunteer and part-time staff member of the Cook Islands Environment Service, is a part-time technical advisor to the TCAP and has been contracted by the Avifauna Conservation Programme for five months each year to work on the Kakerori Recovery Programme. Mataiti Mataiti was appointed as a TCA ecotourist guide in 1998, and helped with both the 1998/99 and 1999/2000 annual censuses, the rat poisoning programme and the nest monitoring work.

2. Implementation and results: 1987–1998

In 1987 the kakerori population stood at 38 birds, but it fell to 36 in 1988, and to 29 in 1989, and at that rate of population decline, a population viability analysis showed that there was a 50% chance that kakerori would be extinct by 1998. An intensive programme of rat poisoning and nest protection began in spring 1989. During each subsequent breeding season, rats have been poisoned in all or part of the 155 ha of forest occupied by kakerori (Robertson et al. 1998), and the effectiveness of this work has been measured by recording breeding productivity (Saul et al. 1998) and by undertaking an annual census the following spring (Robertson 1998, 1999). The kakerori population had recovered to 171 birds by 1998.

3. Aims of 1999 visit

The aim of my visit in August–September 1999 was to provide scientific advice to the Kakerori Recovery Programme and the TCAP. Specifically, I helped to:

- Carry out a detailed pre-breeding season population assessment
- Colour-band as many birds as possible to enable the annual 'roll-call' of birds
- Collect blood smears from kakerori and other wild birds in order to assess disease risk of transferring kakerori to other islands in the southern Cooks
- Collect blood samples to assess genetic variation in kakerori (with Bob Montgomerie of Queens University, Canada)
- Help design the 1999/2000 field programme which is being done by staff of the TCAP
- Refine the long-term sustainable management programme in the TCA
- Train local staff in field techniques

4. Results: August–September 1999

4.1 KAKERORI CENSUS

The Kakerori Recovery Programme was again successful in 1998/99, with the population growing by 8% from 171 birds to a minimum of 184 birds. This year, at least 32 yearlings were recruited into the population. Although this figure was up on the previous year (25 yearlings), it was less than expected because a record number of fledglings (59+) were produced in the 1998/99 breeding season, which means that survivorship was 54% compared with the long-term (1987–98) juvenile survival rate of 82%, which would have produced 49 yearlings in August. We suspect that recently fledged juveniles may have succumbed during a prolonged period of wet and windy weather in Rarotonga in the first three months of 1999 (861 mm of rain fell over 75 of the 89 days in January–March at Totokoitu Research Station, 1 km away from the centre of the TCA (New Zealand Climate Digest records).

The survival of adults was again very good at 88.9%, although this was slightly down on the long-term average in managed years (1989–98) of 94.0%, again possibly because of the prolonged period of poor weather. An unusual feature this year was that more grey birds (4+ years old) died (12.6%), than those aged 1–3 years old (9.2%)—see Robertson et al. (1993) for details on determining the age of kakerori. The overall adult survivorship remains outstandingly high, with 18 of the 29 birds alive in spring 1989 still being alive ten years later. Three grey birds banded by Rod Hay and Gerald McCormack in 1984 are now at least 19 years old. This study has confirmed that some birds in the tropical and temperate Southern Hemisphere have quite different life-history strategies from those in the Northern Hemisphere, where most ecological theory has developed.

The census is becoming more difficult and time-consuming as the population has increased; however, we are lucky that the range of the birds has increased only marginally since 1989. This year, we recorded birds for the first time in the two valleys immediately downstream from the edge of the breeding range in the TCA on the true right of the Avana Valley, but these birds appeared to be unpaired in August 1999. In February 2000, Ed Saul checked a valley in the lower Totokoitu catchment and discovered a pair of banded grey birds that had been last seen in the TCA as a three-year old and as a yearling in 1996.

One reason why the annual census result is conservative is that some young birds probably leave the TCA temporarily or permanently. For example, we followed up a very reliable sighting of an unbanded orange kakerori at the lowest stream crossing on the Cross-Island Walk in the Papua Valley on 20 August 1999. This bird was seen by a scientist, James Briskie, who had just spent a couple of days with us; however, we failed to find any trace of it on 25 August, and a fairly thorough search of promising habitat higher up the valley and on the upper part of the Papua–Taipara ridge failed to reveal any birds. We concluded

that this bird must have been wandering widely at the time, and may well return to the TCA to be included in the 2000 census results.

4.2 MIST-NETTING AND COLOUR-BANDING

Ed Saul, Greg Sherley, Mataiti Mataiti, and I mist-netted and colour-banded 10 of the 32 yearlings, plus we saw all 5 yearlings that Ed Saul and I had banded in April 1999. We also caught and colour-banded eight older birds (two 2-year olds, three 3-year olds and three 4-year olds) and recaptured a banded 4-year old bird. This brought the number of colour-banded birds to 120 (65%) of the 184 birds in the TCA which enables the annual roll-call and census to be reasonably accurate, although somewhat conservative. For example, our estimate of the 1998 population size grew from the 160 birds found in August 1998 to 171 birds after our 1999 census and 1999/2000 breeding season observations. This followed the discovery of a pair missing since 1996, a male missing since 1997, and a few unbanded or colour-banded birds missed in August 1998. Our estimate of the number of yearlings in 1998 increased from 22 to 25 following sightings of banded and unbanded 2-year old birds in 1999.

4.3 BLOOD SAMPLING

We collected blood smears and small blood samples from 18 of the 19 kakerori that we handled. These were collected from the brachial vein of the bird with a syringe with a very fine needle (26G-27G), and then single droplets were placed on two microscope slides, and the rest onto blotting paper. The droplets were then smeared by drawing a cover slip gently across the blood droplet. Most birds suffered minor stress from this operation compared with normal handling (banding, measuring, and weighing), but almost all birds sampled were later seen alive and well several days later. We also collected blood smears from an I'oi, or Rarotonga starling, that we caught incidentally in a mist-net in the Turoa Valley—this is the first I'oi we have caught since 1987. Before my visit, Ed Saul and Mataiti Mataiti collected blood smears from six Mynas around the Upper Tupapa–Matavera district, and I helped to collect a further 3 samples at Upper Tupapa.

The blood smears were inspected by Ray Lanham, a veterinary haematologist at Alpha Scientific Ltd, Hamilton, New Zealand. No blood parasites were seen in any of the 28 blood smears. Sixteen of the 18 smears from kakerori, the I'oi sample, and 5 of the 9 Myna samples were of suitable quality to carry out Whole Blood Counts, and further inspection of red cells and thrombocytes. In all cases, red cells appeared normal and thrombocyte morphology and numbers appeared normal, thus indicating that none of these birds was suffering from blood disorders such as avian malaria.

Because kakerori have been through a severe bottleneck (only 13 pairs in 1989), their genetic diversity may be reduced, and so less able to cope with changing environmental conditions, exposure to disease, or suffer from inbreeding depression. Dr Bob Montgomerie (Queens University, Canada) and Dr James

Briskie (University of Canterbury, New Zealand) accompanied us into the field for a few days to help show how to collect and store blood samples. The 18 blood samples we collected were sent to Bob Montgomerie for DNA analysis of the genetic diversity in the kakerori population, but results are not yet available.

4.4 RAT CONTROL

I helped to design the 1998/99 rat control programme with the aim of reducing labour and poison bait costs, and to reduce the amount of poison used. The poisoning started a fortnight earlier than usual, but there was a major reduction in the density of bait stations around the perimeter of the valleys, so that 370 rather than 599 bait stations were serviced each week. The bait take in the early part of the season was exceptionally high, but we saw more than a dozen rats out during daylight hours during the August 1998 census, indicating that the rat population was very high at the time. The breeding results in 1998, and census results in 1999 indicated that this new poisoning regime gave adequate protection to kakerori, even in a year with very high rat densities. We decided to maintain this system of rat control in 1999/2000, before carrying out any further modifications.

Ship rats (*Rattus rattus*) are believed to be the main threat to kakerori, rather than the kiore or Pacific rat (*Rattus exulans*), and they are also believed to dominate the smaller kiore and so perhaps gain preferential access to the poison bait (Ian Atkinson, pers. comm). If this was the case, then poisoning could potentially cease once the local ship rat population had been eliminated, thereby greatly reducing the poisoning season, or reducing it to a couple of pulses, rather than being done continuously for 13 weeks under the current regime. We decided to investigate the relative abundance of each species during the poisoning season by kill-trapping rats in a poisoned and an unpoisoned area during the course of the season. Preliminary results show that both species were present throughout the season in both poisoned and unpoisoned areas, albeit at lower densities in the poisoned area.

In 1997/98, we specially imported 'tropical formulation' Talon baits from Australia and tested their persistence and palatability against the cheaper standard Talon baits from New Zealand. We discovered that the tropical baits did not deteriorate as fast in the hot humid weather as did standard baits, but also discovered that they were far less palatable to rats than the standard baits. We did not use any tropical baits in 1998/99, but decided to carry out a scientific trial in 1999/2000 by dipping the baits in, or spraying them with coconut oil, in an attempt to make them more palatable. Results of the palatability trial showed that coconut oil sprayed on the 'tropical formulation' baits did indeed make the baits more palatable to rats and about as palatable as standard baits, but also led to slightly greater insect damage too. Our recommendation is that 'tropical formulation' baits should be sprayed with coconut oil, at least in tropical sites where coconut is a normal part of the diet of the local rats.

4.5 TCA LIAISON

I attended two meetings of the Takitumu Conservation Area Project Co-ordinating Committee (landowners) as a scientific advisor to the committee. At one of the meetings, attended by I'o Tukeu-Lindsay, Director of the Cook Islands Environment Service, Greg Sherley (Avifauna Conservation Programme officer in SPREP) outlined the arrangements between his funding of the Kakerori Recovery Programme and the management of the TCA. The possible transfer of kakerori to another island in the southern Cooks was viewed by some on the TCA committee as possibly threatening their business because kakerori would no longer be confined to their land. However, others at the meeting saw this as a prudent insurance policy, so that if disaster (cyclone, disease, or new predators) hit Rarotonga, the birds could be returned to their natural range. Ecotourists are unlikely to bypass the TCA population in favour of one on an outer island, because the TCA population would remain the only natural population. The TCA is very accessible to tourists as the international airport is on Rarotonga, and so all ecotourists (bar a few yachties) must pass through Rarotonga.

4.6 OTHER

I helped Ed Saul to do the annual census of the rare *Habenaria* orchid, which was flowering during my visit. The numbers were well down on previous annual counts, but it is unclear yet if this is part of a natural cycle in numbers, or if there is a serious problem with the species.

During searches for kakerori in valleys outside the TCA, I was impressed by the paucity of lizards. In the TCA, where rats have been poisoned for 10 years, ground-dwelling lizards are extremely common, and virtually always one or more is in sight. In valleys from 200 m up to 2 km away from the TCA, I saw only a handful of lizards all day. It therefore seems likely that lizards have also benefited from the reduction in the numbers of rats and cats in the TCA as a result of the rat-poisoning programme.

5. The future

The unofficial aim of building kakerori numbers up to 100 by the end of the century has already been achieved and we are now aiming to have 200 birds in the August 2000 census. Continued population growth seems assured with the injection of support to the project from the Avifauna Conservation Programme of SPREP. BirdLife International have agreed to downgrade the threatened status of kakerori from 'critically endangered' to 'endangered' for their 2000 edition of Birds to Watch. This will be one of only a handful of species to be downgraded, and possibly the only one to shift from 'critically endangered' to 'endangered' as a result of *in situ* management (Alison Stattersfield pers. comm.). The success of the Kakerori Recovery Programme was highlighted during a 20-minute

presentation ('A Bird Conservation Programme in Rarotonga, Cook Islands: the case of the kakerori' by Anna Tiraa, Hugh Robertson, and Ed Saul) at BirdLife International's Conference in Kuala Lumpur in October 1999.

We are still trying to refine the ongoing rat control programme, mainly through experiments aimed at minimising the labour and poison costs, and minimising the amount of poison put into the environment each year. In the 2000/01 season we may try a new baiting regime, to see if we are 'overkilling' rats in the first part of each baiting season. We usually put out 3 baits per station, but it is possible that a single rat may eat all three baits (only one is needed to kill a rat) and then move to adjacent bait stations and eat their baits too, with the consequent use of far more baits than is necessary. I propose that we put out a single bait in each station in one valley, starting a fortnight or two earlier than at present to try to reduce the rat density early, and then compare the bait take and kakerori breeding success with the normal regime elsewhere. During the later part of the season, we may also run a four-way trial in one valley, with the choices being standard, standard with coconut oil, tropical, and tropical with coconut oil, to compare bait preferences.

The concept of the Takitumu Conservation Area Project, as a community-based and ecologically sustainable conservation venture, is very exciting, and is providing a good model for the integrated management of ecotourism and biodiversity conservation in the South Pacific. The continuing success of the Kakerori Recovery Programme provides a firm basis for attracting tourists to an accessible and biologically interesting conservation experiment, and as mechanism for advertising the TCA to ornithologists.

The severe storm of July 1998 and the spell of bad weather in early 1999, each of which probably killed many juveniles, highlights the vulnerability of kakerori to unusual weather events such as tropical cyclones, droughts or prolonged wet periods. We are now investigating the option of shifting some young kakerori to an island in the southern Cooks that is free of ship rats and preferably cats, and the blood tests reported here give some confidence that kakerori will not pose a disease risk to birds naturally occurring on the possible recipient islands. The current Kakerori Recovery Plan runs out in the year 2000, and Ed Saul is contracted by the Avifauna Conservation Programme of SPREP to revise the plan in conjunction with the Cook Islands Environment Service. This revision should address some of these issues and highlight future innovative management options.

The technology developed during the Kakerori Recovery Programme has now been exported to French Polynesia, where members of the French Polynesian Ornithological Society, *Manu*, with assistance from the Pacific Development & Conservation Trust and SPREP's Avifauna Conservation Programme, have started management of the critically endangered Tahiti flycatcher *Pomarea nigra*. There are many other threatened birds in the South Pacific region that could also benefit from the sort of management being developed in Rarotonga, and several conservation authorities are looking closely at our work on assessing, and improving on the palatability of 'tropical formulation' Talon baits.

6. Acknowledgements

Many thanks to Ed Saul, Mataiti Mataiti, and Greg Sherley for their great help in the field during my visit. Ian Karika-Wilmot, Support Officer of the Takitumu Conservation Area made me especially welcome and allowed me to use the TCA motorbike during my stay. Bob Montgomerie and James Briskie showed us the techniques for collecting blood samples for DNA testing. Ian Atkinson provided useful advice about the ecology of rats. Ed Saul and Maddie Midwinter again provided very warm hospitality throughout my stay, without which the hard work in the hills would be even tougher. SPREP's Avifauna Conservation Programme paid for my travel expenses this year, and the Department of Conservation allowed me 16 days of special leave on pay during the 24 days I was in Rarotonga. Greg Sherley and Ed Saul made helpful comments on a draft of this manuscript.

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