Conservation of kakerori (*Pomarea dimidiata*) on the Cook Islands in 2002/03

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ABSTRACT

In 1989, the kakerori (*Pomarea dimidiata*) was one of the 10 rarest bird species in the world with a declining population of just 29 birds. During each breeding season since then, rats have been poisoned within the 155 ha of forested hill country they occupy in southeastern Rarotonga. As a result, the kakerori population has rebounded, with a minimum of 259 birds being found on Rarotonga in August 2002. In 2001 and 2002, 20 yearlings were transferred to Atiu in the first two of three planned annual transfers to establish an 'insurance' population. In January 2003, three pairs of kakerori were found on Atiu, and successful breeding was proven with the discovery of six island-bred (unbanded) birds, belonging to at least two of the pairs. In 2002/03, the emphasis of management in the Takitumu Conservation Area shifted from the 'recovery' of kakerori to a programme aimed at 'sustaining' the population at about 250 individuals. The key to this work was the experimental reduction of rat poisoning effort, so that 30 territories had the standard weekly refills of poison bait stations, 29 received a fortnightly refill, and 20 received no rat control. As expected, breeding success was significantly better in poisoned areas (with an average of 0.95 fledglings per breeding territory) than in unpoisoned areas (with an average of 0.30 fledglings per breeding territory). This reduced rat control programme took 2–3 person days each week for 15 weeks, and used a total of 43 kg of Talon® (active ingredient brodifacoum), which was about 20% of peak poison use during the 'recovery' phase of the programme. The fortnightly poisoning regime offers promise as an effective, cheaper and less toxin-intensive method than that used previously.

Keywords: kakerori, *Pomarea dimidiata*, recovery programme, translocation, rat control, Rarotonga, Atiu.

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1. Introduction

In a review of bird conservation problems in the South Pacific, commissioned by the South Pacific Regional Environment Programme (SPREP) and the International Council for Bird Preservation (now Birdlife International) 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).

The kakerori is a small (22 g) forest passerine, which is endemic to Rarotonga. In the mid-1800s, kakerori were reported to be common throughout the island, but by the early 1900s they were thought to have become extinct. In the 1970s a small population was rediscovered in the rugged inland hills of the island. In 1984, it was estimated that the population was about 25 birds; however, we now know that this was pessimistic because a thorough survey in 1987 found 38 birds. Kakerori display an interesting variety of plumages, and it was not until birds were individually colour-banded that it was shown that males and females show the same set changes in plumage patterns: all yearlings are orange, with a yellow base to their bill; all 2-year-olds are orange, with a dark blue base to the bill; 3-year-olds are a variable 'mixed' colour, ranging from some females that are blotchy grey and orange, through to some males that are entirely grey apart from the odd orange feather; all birds 4 or more years old are grey (Robertson et al. 1993).

Most 1- and 2-year-old kakerori form loose flocks on the ridgetops, away from occupied territories; however, some join adults as 'helpers' to help to defend a territory and raise young. Most territories are in valleys, especially those sheltered from the prevailing south-east trade winds. Adult kakerori are strongly territorial and remain on their territory throughout the year. They breed from October to February, though most eggs are laid in October and early November. They lay 1–2 eggs in a bulky nest, often placed on a forked branch overhanging a creek. Replacement clutches are laid if nests fail, but kakerori usually do not re-lay after successfully fledging young (Saul et al. 1999).

As a result of a study between September 1987 and January 1998, Rod Hay and Hugh Robertson confirmed that the conservation status of kakerori was 'critically endangered' (Collar et al. 1994). They also reported to the Cook Islands Conservation Service (now Cook Islands Environment Service) and SPREP that ship rats (*Rattus rattus*) were having a very detrimental effect on the breeding of kakerori, and that cats (*Felis catus*) were likely to be predators of recently fledged juveniles and adult birds. The draft plan for the recovery of kakerori recommended a cost-effective experimental recovery programme targeting predators of kakerori and scientific study aimed at assessing the effectiveness of this work.

2. Objectives

The original objectives of the Kakerori Recovery Plan were to:

1. Monitor, on an annual basis, the dynamics of the kakerori population on Rarotonga.
2. Research, develop and implement an effective predator (rat and cat) control programme.
3. Research, develop and implement a programme of managing the kakerori population by protecting nests, providing supplementary food, and as a last resort by translocation or captive breeding.
4. Describe the habitats used by kakerori, and determine the relationship between habitat features and the distribution of kakerori.
5. Develop, and implement a programme of public education, awareness and participation in the kakerori conservation programme.
6. Encourage the protection of kakerori by creating a suitable reserve, and development of appropriate national and international policies regarding the scientific collection or trade in kakerori, and the importation of wildlife (and hence potential diseases) into the Cook Islands.

Our unofficial goal was to have over 100 kakerori by the year 2000.

The Kakerori Recovery Plan was updated in 1995 by the Cook Island Environment Service (Saul 1995). This re-affirmed the above objectives, but changed the emphasis of Objective 3 by promoting a feasibility study into the possibility of establishing an 'insurance' population of kakerori on another island in the southern Cooks which is free of ship rats (e.g. Aitutaki or Atiu).

In 1996, SPREP adopted a joint proposal by the Cook Islands Government and the Takitumu Conservation Area (TCA) Co-ordinating Committee (representatives of the three customary land-owning families involved) that the 155 ha area of the southeastern part of Rarotonga (Fig. 1), which is home for the kakerori, be adopted as a Conservation Area as part of the South Pacific Biodiversity Conservation Programme (SPBCP). The goal of the project in the TCA is to 'conserve the Conservation Area's biodiversity for the benefit and enjoyment of present and future generations on Rarotonga'. More immediate objectives were to:

1. Develop partnership arrangements between government, landowners, NGOs and others for effective management and sustainable use of biodiversity in the TCA.
2. Develop and implement management plans for the wise use of biodiversity within 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.

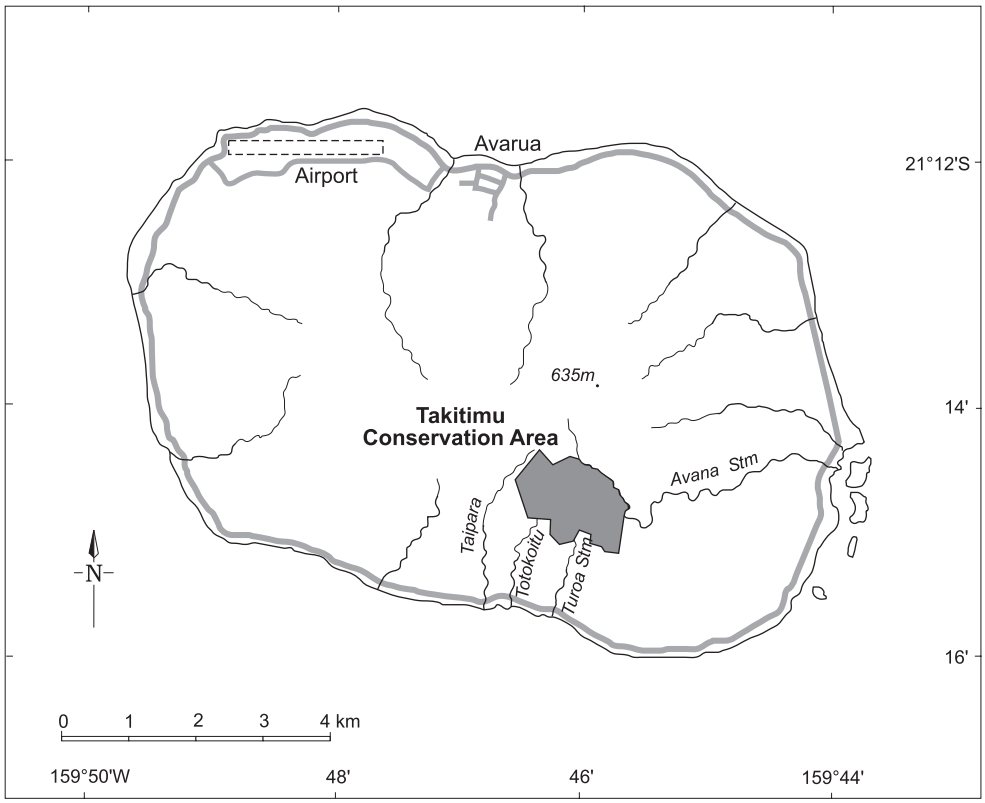

Figure 1. Map of Rarotonga showing the location of the study area in the Takitimu Conservation Area.

The TCA project was funded by the SPBCP for the five years to June 2001, and received partial support for another year as the programme funding wound down. It has attempted to make its own way mainly through a landowner-led ecotourism venture. 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, four of the six seabird species breeding on Rarotonga, a fruit-bat colony, several species of lizards, and several rare shrubs and orchids.

The Polynesian Avifauna Conservation Workshop identified the kakerori Recovery Project as a flagship bird conservation project in Polynesia (Sherley 2001), 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 kakerori is of wider application than just the management of the TCA, the Avifauna Conservation Project of SPREP supported the scientific costs of the project from 1999 to 2001. They also contributed some costs associated with the first two of the three planned transfers of kakerori to Atiu to establish an 'insurance' population.

3. Kakerori population, 1987–2001

In 1987, the kakerori population was 38 birds, but it dropped to 36 in 1988, and then to 29 in 1989. At that rate of population decline, a population viability analysis showed that there was a 50% chance that kakerori would be extinct by 1998, and a 90% chance by 2002. An experimental programme of rat poisoning and nest protection started in spring 1989, with careful measurement of the breeding success and survival of kakerori inside and outside of the treated areas. During each subsequent breeding season, rats have been poisoned in all or part of the 155 ha of steep forest country occupied by kakerori (Robertson et al. 1998). The effectiveness of the work has been measured by recording breeding productivity (Robertson et al. 1998, Saul et al. 1998), recording the survivorship of individually colour-banded kakerori, and undertaking an annual census each spring. The census is made easier by the progressive fixed changes in bill colour and plumage of kakerori during their first four years of life (Robertson et al. 1993) which allows the survival of unbanded birds to be estimated accurately. Kakerori population has increased each year since 1989, reaching 100 birds by 1995, 200 by 2000, and 248 birds (minus 10 transferred to Atiu) in August 2001. In 2000, Birdlife International downgraded the threat ranking of kakerori from 'critically endangered' to 'endangered' (Birdlife International 2000), one of a very few species to have been downgraded as a result of conservation management success rather than improved knowledge (Allison Statterfield pers. comm.).

4. Field programmes since 2002

The emphasis of the programme shifted in 2002 from recovery of kakerori towards one aimed at sustainable management of the population, so that their numbers remain at about 250 individuals on Rarotonga. A species population of this size, while being small by international standards, is probably sufficient to withstand normal demographic perturbations and maintain adequate genetic diversity, especially given the extreme longevity of kakerori and the evenness of reproductive output among individuals. This single population on Rarotonga, however, remains highly vulnerable to catastrophic decline or extinction caused by a major environmental disaster such as a large cyclone hitting Rarotonga, a new avian disease or predator (e.g. brown tree snake) reaching the island, or a fire sweeping through the TCA in a dry summer. Consequently, we are in the process of establishing an 'insurance' population on Atiu which, if successful, should lower the risk of extinction of kakerori, and allow birds to be returned to Rarotonga if they should ever die out there.

In 2002, the TCA received three years of funding from the Pacific Initiative for the Environment of the New Zealand Official Development Assistance (now New Zealand Agency for International Development) to refocus the project in this way from recovering the population of kakerori from close to extinction, to sustaining the population at about 250 individuals on Rarotonga. It also provided for securing an 'insurance' population on Atiu through at least one more transfer of 10 birds in August 2003, and monitoring of the success of the transfers. The TCA also received assistance from the Pacific Development and Conservation Trust, mainly for costs associated with the 2002 rat control programme, track maintenance, and making interpretation panels for the visitor centre in the TCA.

The objectives of the 2002/03 field season were to:

1. Conduct the annual pre-breeding census and territory mapping of kakerori.
2. Mist-net and colour-band as many kakerori as possible to enable the annual 'roll call' of birds, and to record the breeding productivity and survival of each individual.
3. Reduce the annual rat poisoning effort by maintaining the weekly replenishment of baits only in the Turoa Valley, and replenishing baits fortnightly in the Totokoitu and Lower Avana Valleys, and around the perimeter of these three valleys.
4. Compare the breeding success and number of fledglings produced in those territories subject to weekly, fortnightly, and no rat poisoning efforts.
5. Transfer a further 10 juvenile kakerori to Atiu in early spring.
6. Monitor the survival of kakerori on Atiu, and determine if they have bred.
7. Report results back to the Cook Islands community.

5. Results and discussion

5.1 KAKERORI CENSUS

The kakerori census was conducted in August 2002; however, a few additional birds were included after being seen during the course of the 2002/03 breeding season.

The Kakerori Recovery Programme was again shown to be very successful in 2001/02, with the population on Rarotonga growing 8.8% from 238 birds (after the removal of 10 birds to Atiu in August 2001) to 259 birds. In August 2002, at least 53 yearlings were recruited into the population, only marginally down from the record 55 yearlings the previous season. Once the second batch of 10 youngsters was transferred to Atiu, we were left with 43 yearlings in the population of 249 birds.

Apparent adult survival (86.6%) was the lowest in the last 12 years, and well below the long-term average of 91.8% since conservation management began in 1989. This decrease in survival is not entirely surprising, because as the

population has expanded its range, more individuals are now living outside the managed areas and so do not receive protection from predators. This year, young adults (ages 2–3) had disproportionately high disappearance rates (18% compared with 10% for older, grey-coloured, birds), and this may indicate that some non-territorial birds had dispersed out of the survey area to seek empty territories, rather than having died. The overall adult survivorship of kakerori remains remarkably high, and life expectancy of an adult is 11.6 years; however, two birds initially colour-banded by Rod Hay and Gerald McCormack in 1984 are now at least 22 years old, and still breeding.

The census is becoming more difficult and time-consuming as the population has increased, and also expanded its range. In 2003, we discovered that kakerori had become firmly established in the Taipara Valley, with four, possibly five, pairs present, compared with two pairs the previous year. kakerori were present in this valley in the early 1980s, but had died out there before our first systematic search and census in 1987.

5.2 MIST-NETTING AND COLOUR-BANDING

During the August census and in early September we set mist-nets on most days, and caught and individually colour-banded a total of 20 birds, 14 yearlings and six 2-year-olds; however, 10 of the yearlings were transferred to Atiu (see below). After the breeding season, volunteers from the University of Edmonton in Canada caught and banded five fledglings, two yearlings, two 3-year-olds, and five older (grey) birds. The nine captures of adult birds brought the total number of colour-banded adult birds up to 119, and maintained the percentage of colour-banded kakerori at just under 50%.

5.3 RAT POISONING

As we had expended more effort controlling predators during the 'recovery' phase of the programme than was necessary to simply 'sustain' the population of kakerori, we designed a rat poisoning experiment to test the effect of reducing poisoning effort from the standard regime of weekly poisoning for 15 weeks in three valleys. The regime introduced in 2002/03 was intended to reduce both the effort and the amount of toxin used, which would save costs as well as reduce the amount of toxin put into the environment. As in previous years, not all breeding territories of kakerori could be protected by rat poisoning, so we used three treatments: standard weekly poisoning in 30 territories in the Turoa Valley, fortnightly poisoning in 29 territories in the Totokoitu and Lower Avana Valleys, and 20 unpoisoned territories in the Upper Avana Valley, and in parts of the Totokoitu and Lower Avana Valleys (Fig. 1). In addition, baits were replenished fortnightly on a circuit around the outside of the valleys to try to reduce the rate of reinvasion of rats into the breeding territories.

The overall pattern of bait take in the Turoa Valley (weekly baiting) was similar to the average pattern observed during the previous five years (1997–2001),

with most bait taken by rats in the first 5–6 weeks (late September and October), then dropping away through November before picking up slightly in December (Fig. 2). The bait take in the Totokoitu Valley (Fig. 3) and Lower Avana Valley (Fig. 4) remained higher than usual for longer, and did not really drop off until about 11–13 weeks after 1 September (i.e. mid- to late November). The poison bait take around the perimeter was not dissimilar to the normal pattern of bait take (Fig. 5). When corrected for baiting frequency (i.e. by recording take as though bait stations were checked fortnightly in the Turoa Valley), the patterns of bait take within the three valley systems were quite similar, but the bait take dropped off about a fortnight earlier in the Turoa Valley (Fig. 6).

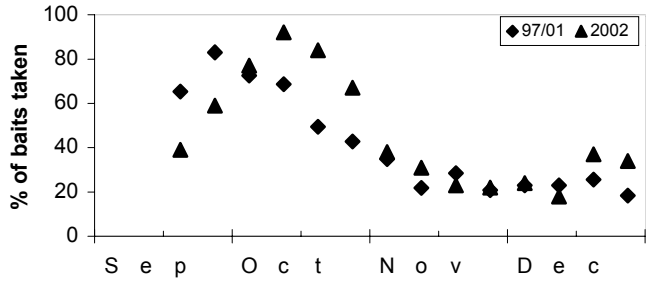

Figure 2. Bait removal by rats, Turoa Valley, weekly baiting, mean 1997–2001 and 2002.

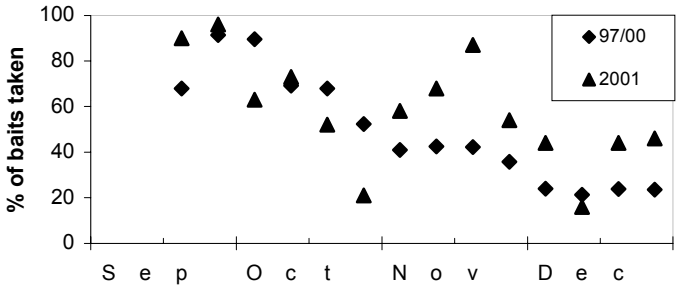

Figure 3. Bait taken by rats, Totokoitu Valley, weekly baiting 1998–2001 and fortnighly baiting 2002.

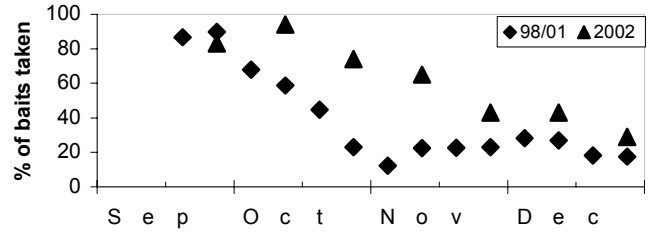

Figure 4. Bait taken by rats, lower Avana Valley, weekly baiting 1998–2001 and fortnighly baiting 2002.

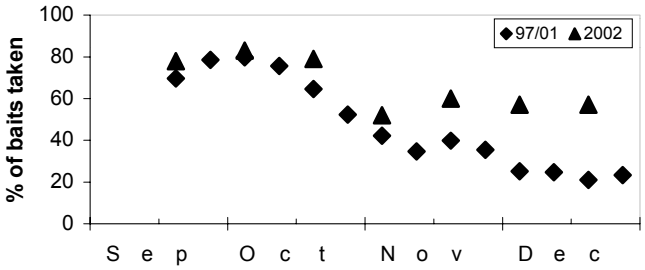

Figure 5. Bait taken by rats round perimeter of study area, weekly baiting 1997–2001 and fortnighly baiting 2002.

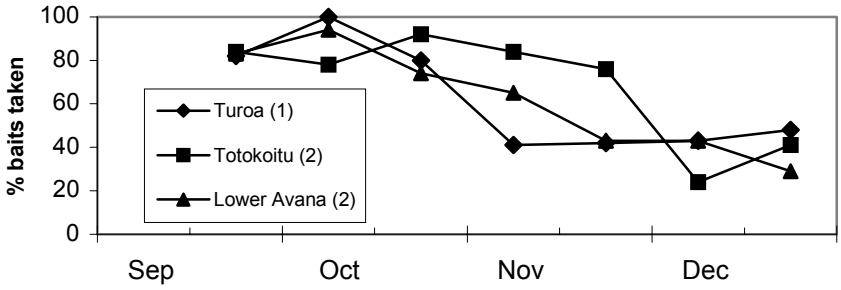

Figure 6. Corrected bait take by rats in three valleys, fortnighly baiting 2002.

The baiting regime in 2002/03 took 4.5 person days per fortnight, 2 days in one week and 2.5 in the alternate week, whereas the previous weekly regime took 3.5 days each week, an overall reduction of 36%. The total bait taken by rats in 2002/03 totalled 42.9 kg compared with 52.2 kg in 2001/02, an 18% decrease. This season represented a further refinement to our baiting regime, which has aimed at progressively reducing toxin use in recent years; the amount of bait taken this year was only 20% of the 213 kg taken in the same geographical area during the peak year (1991) of bait use, when three baits were deployed per bait station for most of the season, and bait station density was higher (Robertson et al. 1998).

5.4 BREEDING SUCCESS

As expected, breeding success was significantly better in poisoned areas (0.95 fledglings/breeding territory) than in unpoisoned areas (0.30 fledglings/ breeding territory). Breeding success was similar in areas receiving weekly and fortnightly rat poisoning (0.97 and 0.93 fledglings/territory, respectively), indicating that the latter poisoning regime was adequate to reduce rat densities to a level which allowed most kakerori to nest successfully. Throughout the TCA, at least 63 fledgling kakerori were found after the breeding season, similar to the productivity recorded over the last two seasons (73 and > 50, respectively). If survivorship of these young kakerori is similar to normal (75%), there are likely to be sufficient yearlings recruited to more than balance the annual adult mortality, and allow a further batch of 10 young kakerori to be transferred to Atiu in the third of three planned transfers. The final results of productivity and survival from this season were expected to show that the population of kakerori was at least maintained at about 250 birds.

5.5 ATIU TRANSFERS

Between 15 and 24 August 2002, 10 yearling kakerori (6 females and 4 males) were mist-netted in the TCA and transferred to Atiu in batches of 1–5 birds. Most birds were caught in the late afternoon, held overnight in transfer boxes, and flown to Atiu on a scheduled flight the following morning. The birds were released within 18 hours of capture, and all flew off strongly when released in the vicinity of the Atiu Motel, near the centre of the 2600 ha island. None of the 20 birds released on Atiu has reappeared on Rarotonga.

5.6 ATIU MONITORING

George Matearíki has kept an eye on kakerori on Atiu since the 2001 release, and has also solicited the local community for records of birds seen around the island. Two pairs from the original 2001 release were monitored in the 2002/03 season, and both bred successfully. They raised at least three fledglings between them, thus proving that conditions on Atiu are suitable for kakerori to breed. Of particular interest, was the observation that nests were constructed mainly from the needles of *Casuarina* trees, in the absence of *Aerobryopsis*, the moss typically used for nest construction on Rarotonga. This adaptability in behaviour augers well for their future on Atiu.

In January 2003, George Matearíki and Ed Saul carried out a wider search for kakerori on Atiu, and played tapes as they went. A third pair was found, but their ages and identity could not be determined, because they did not react strongly to the tapes. Although only six of the 20 birds taken to Atiu were detected, it is likely that this is an underestimate of the actual numbers because only a small part of the 2600 ha island was surveyed. Large parts of Atiu are of makatea (raised coral) which is very difficult to traverse as there are no roads or foot tracks in these rough areas. The island also has many small forested valleys among cultivated areas, and birds could live quietly in these patches without being detected.

By May 2003, at least six Atiu-bred (i.e. unbanded) birds had been located by George Matearíki, including the three fledglings noted above.

5.7 ADVOCACY

We, and the Canadian volunteers, were interviewed on Cook Islands television and by the Cook Island News about the second transfer of kakerori to Atiu, the August census results, and the success of the breeding season. We have prepared text for three posters (on kakerori, The Kakerori Recovery Programme, and the Takitumu Conservation Area Project) to be placed in the visitor shelter in the Takitumu Conservation Area. We are now awaiting more photographs, and the translation of these texts into Cook Islands Maori, so that bilingual texts are presented. The text for five other posters (wildlife, plants, medicinal plants, streamlife, and rat control) are being prepared.

6. Future programme

The 2002/03 season marked a turning point in the Kakerori Recovery Programme, from one aimed principally at 'recovery' to one aimed at 'sustainability'. A key element of this shift is a reduction in management effort on Rarotonga to a level which maintains the kakerori population at about 250 individuals, but which is also both physically and economically sustainable in the long term. A move to fortnightly poisoning would seem to offer the

possibility of halving rat poisoning effort, without significantly altering the breeding productivity of kakerori. We also recommend that this fortnightly rat poisoning programme should commence a fortnight earlier than usual (i.e. early September) so that rat numbers are markedly reduced before the late October peak of breeding effort by kakerori.

The other element in the move to 'sustainable' management of kakerori on Rarotonga, is the establishment of an 'insurance' population on Atiu, should some environmental disaster strike Rarotonga. The second year of transfers went well, and the detection of successful breeding on Atiu suggests that kakerori will become established there. In order to expand the founding gene pool on the island, and so avoid inbreeding depression, we propose to transfer a third batch of 10 juveniles, using the successful methods employed in 2001 and 2002.

The kakerori is still not legally protected, despite earlier representations to the Environment Service to get the species listed under the Environment Act. The vulnerability of kakerori was highlighted by the discovery that an American museum collected two kakerori specimens in 1984 without receiving any permission. Efforts will again be made to get the kakerori, and other native wildlife, legally protected during the current revision of the Environment Act.

7. Acknowledgements

The Department of Conservation, New Zealand, allowed Hugh Robertson to take special leave on pay to assist with the field project. The Avifauna Conservation Programme of SPREP supported his travel costs in August 2002, the costs associated with the 2002 census, and the transfer of kakerori to Atiu. The Pacific Development and Conservation Trust paid for costs of the rat poisoning effort in 2002/03, and track maintenance. The Pacific Initiative for the Environment paid for the costs of monitoring the breeding outcomes in territories under each of the three different management regimes, and monitoring birds on Atiu. The TCA Project contributed substantially by covering vehicle running costs, poison bait supply, and the provision of accommodation on Rarotonga for volunteers to help with the field programme.

Barbara Maile, a graduate student at the University of Alberta in Edmonton, Canada, provided invaluable assistance for much of the field season, but also organised a series of undergraduate students from her faculty (Suzanne Card, Jennifer Carpenter, Erin Klassen, Kathy St Laurent, Nerissa Harvey, Christine Boulton and Bryn Jonzon), to come to Rarotonga as volunteers to assist with the programme.

Ian Karika, manager of the TCA Project, assisted in many ways with technical support, fund-raising, and especially with the Atiu transfers and the refurbishment of a somewhat 'tired' house into a comfortable field base for the volunteers. Anna Tiraa assisted with the capture of birds for the transfer, and Diana Dombroski and other casual volunteers helped with the rat poisoning

effort. George Matearikiand Roger Malcolm assisted with the Atiu end of the project, especially with the release of kakerori, and George has diligently monitored the birds, and maintained rat poison in bait stations around the port.

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