

ABSTRACTS

The following pages contain abstracts for papers which were presented at the conference, but for which the authors have chosen not to prepare a full written paper.

These abstracts are given in the alphabetical order of the person who presented the paper at the conference (the name shown in bold type). The address of the presenter is given with each abstract.

Removing a diverse suite of invasive threats to recover an endangered Hawaiian bird species and its dry forest habitat

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Recovery of the Hawaiian forest bird community that includes the endangered palila (*Loxioides bailleui*) requires removing a wide array of invasive pests and weeds from subalpine dry forest habitat on Mauna Kea volcano. Palila are threatened by predators and food competitors, and their habitat is threatened by aliens that browse native vegetation, increase fire fuel levels, and suppress forest regeneration. Due to these and other factors, most palila are concentrated in only 30 km² of habitat. In addition, the palila is a seed specialist that obtains most of its food resources from mamane (*Sophora chrysophylla*), an endemic leguminous tree that is sensitive to browsing by feral sheep, mouflon sheep, and cattle. Episodically during the past two decades, sheep and mouflon populations have been reduced, resulting in mamane regeneration in many areas. However, annual counts suggest that the palila population may not benefit from these habitat improvements until saplings have grown larger. Invasive annual grasses suppress mamane regeneration and accumulate as fire fuel, and an alien vine overgrows trees. We are mapping the distribution of these and other weeds to facilitate control strategies. We are investigating the ecology of alien mammals to develop control priorities and strategies. Feral cats and black rats destroy many palila nests, and the tendency of birds to roost repeatedly in the same trees may increase their vulnerability to mammalian predation. Cats are readily trapped, but tracking studies indicate that immigrants will arrive from far outside control areas. Cats on Mauna Kea seem to prey more on birds than on house mice; therefore, reducing mouse populations may have little impact on cat numbers. Mice are abundant in palila habitat and are active in tree canopies, but their potential threat to palila or the forest is unclear. Threats to insect food resources of palila include alien wasps that parasitise and prey on caterpillars. Ants also are spreading into palila habitat and threaten the entire insect community. Protecting and enhancing the main palila population and re-establishing another population elsewhere on Mauna Kea depend on the effectiveness of reducing the impacts of this complex suite of invasive aliens.

Introduced Neotropical tree frogs in the Hawaiian Islands: Control technique development and population status

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Two species of Neotropical tree frog (*Eleutherodactylus coqui* and *E. planirostris*) have been introduced into the Hawaii Islands via the horticulture trade. Since 1997 frog colonies within the state have rapidly spread accidentally and intentionally and frog abundance within colonies has grown rapidly. Colonies of these frogs are currently known from 150+ locations on the island of Hawaii, 35+ on Maui, 5+ on Oahu, and one on Kauai. Although these frogs were originally restricted to horticulture sites, they are now found in residential areas, resorts and hotels, and public lands. Individual frogs or frog colonies have been verified at sites ranging from sea level to over 3500 ft. Within their native range, where their populations may be restrained via predation and other natural checks, they may reach densities of 20,000 frogs/ha and consume an estimated 140,000 prey items/night. Given the current population irruptions of these frogs in Hawaii, similar densities could be reached or exceeded. Given the high potential biomass of introduced frogs, there are realistic ecological and anthropogenic concerns associated with the spread of these frogs. Currently, there are limited techniques to control these animals. Research has been conducted to evaluate the efficacy of various mechanical and chemical techniques for frog control. Thus far, hand capture and trapping have proven labour intensive for frog control in sites with locally moderate to high frog densities. In collaboration with state pesticide regulatory and wildlife management agencies, we tested 30+ compounds (registered insecticides, surfactants, human pharmaceutical compounds, and food additives) in the laboratory to determine their efficacy for tree frog control. In these trials, caffeine and water solutions proved to be the only compounds that could effectively be used for tree frog control. Currently, field trials are being conducted to evaluate the efficacy of a direct spray application of a concentrated caffeine and water solution for tree frog control on 0.1 - 0.5 ha tree frog-infested plots. If these trials are successful, it is hoped that management agencies in the State of Hawaii will be able to reduce the spread and potential impact of these pest species on a landscape scale.

Tackling tussock moths: strategies, timelines and outcomes of two programmes for eradicating tussock moths from suburbs of Auckland, New Zealand

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Suburb-wide, aerial sprays of an organic insecticide (*Bacillus thuringiensis*) were applied to an infestation of the white-spotted tussock moth (*Orgyia thyellina*) in Auckland, New Zealand, followed by intensive monitoring for the remnant of the population. Caged females in sticky traps caught small numbers of wild males from a tightly localised area. This area was sprayed from the ground and with helicopters. Ground searches for eggs and caterpillars found nothing. The catch in the female-baited traps decreased as the summer programme of targeted sprays continued. A synthetic pheromone was identified from an international effort and deployed in a large number of sticky traps in the second year of the programme. No males were caught. The lures were subject to an independent quality assurance test for attractiveness. The moth was declared to have been eradicated and was not found again during the following two years. A second species of tussock moth (*Teia anartoides*) was found in two Auckland suburbs the following year. Localised ground spraying of infested areas with synthetic insecticides was followed by ground searches for caterpillars. These searches have yielded a steady number of caterpillars for a 12-month period. No attempt to use natural pheromone sources was made, and an attempt to identify the sex pheromone by a local group has failed. The moth continues to be present at the time of writing. The use of pheromones is concluded to be the key tool in any attempt to eradicate an invading moth species.

Recovery of invertebrate populations on Tiritiri Matangi Island, New Zealand following eradication of Pacific rats (*Rattus exulans*)

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The effects of kiore, or Pacific rat (*Rattus exulans*) on indigenous species has historically been based on anecdotal accounts and circumstantial comparisons. The eradication of kiore from 220ha Tiritiri Matangi Island in 1993 provided an opportunity to obtain empirical data on the effects of this rodent on invertebrates. Long term monitoring of ground invertebrates began three months before the removal of kiore and continued for five years following removal. Pitfall traps were set in a mature broadleaf forest remnant and in a younger regenerating forest. Larger numbers of invertebrates were caught in the mature forest and these also increased to a greater degree after rat removal. Capture rates of several large (>10 mm) species increased during the study, including ground weta (Orthoptera: Anostomatidae) and several species of prowling spider (Araneae: Miturgidae). Capture rates of other species that changed over time appear to be correlated with weather that varied dramatically during the period of monitoring. Seasonal changes are reported and the life histories of large flightless, nocturnal ground-dwelling invertebrates are correlated with kiore eradication.

Restoration of tree weta (Orthoptera: Anostomatidae) to a modified island

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Management of Korapuki Island in the Mercury Islands, Eastern North Island, New Zealand, has been centred around restoration activities following eradication of kiore, the Pacific rat (*Rattus exulans*) and rabbits (*Oryctolagus cuniculus*) during 1986-1987. As part of this restoration four lizard species have been transferred to the island and recently the first invertebrate, the Auckland tree weta (*Hemideina thoracica*), was transferred from Double Island, also within the Mercury Islands, to Korapuki Island. Further invertebrate transfers are planned. With relatively few invertebrate transfers recorded in New Zealand, the study aimed to develop protocols for the translocation of invertebrate species. It also aimed to use monitoring methods that measure impacts on the source population and success of the transfer. Artificial roost sites, in the form of wooden blocks with a single hole, were successfully used to monitor both the source population and the transferred population, in addition to facilitating the actual transfer. The criteria used to assess the potential release sites on Korapuki Island, details of the transfer, changes in populations on both islands, and life history information required to assess the likely risks are presented.

Control of cats on mountain “islands”, Stewart Island, New Zealand

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The southern subspecies of the New Zealand dotterel (*Charadrius obscurus*) is currently restricted to nesting areas on the bleak alpine mountaintops of Stewart Island. By the early 1990s the species had declined to a total population of 65 individuals. The principal cause of the decline was attributed to predation by feral cats (*Felis catus*). A cat-control programme was initiated in 1992. The programme involved a perimeter of bait stations set up at the bush-line. Poison baits for cats were presented in these stations during spring and summer, when dotterels were nesting. Research suggests that cats are not resident year-round in the sub-alpine scrub. They generally stray into the sub-alpine scrub and above the bushline during the summer “low” in abundances of rats, their principal prey on Stewart Island. Little alternative prey is available during summer. The cat control appears to have been successful, as the population of dotterels has expanded to 170 individuals by April 2000. Research into the habitat preference of cats is continuing with a view to more efficient use of resources for ongoing cat control.

The status of invasive ant control in the conservation of island systems

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Introduced ants have often been responsible for significant ecological disruption in both continental and insular systems. In the oceanic islands of the Pacific, in particular, ants have long been implicated in the wholesale extirpation of the native lowland arthropod fauna. Three tramp species have been identified as especially invasive and detrimental to native ecosystems: the Argentine ant (*Linepithema humile*), the big-headed ant (*Pheidole megacephala*), and the little fire ant (*Wasmannia auropunctata*). Others are undoubtedly important as well, and on islands where these three species do not occur, the ecological effects of other community-dominant species needs to be assessed. While removal of invasive ant species would benefit many natural areas, attempts at eradication have typically been unsuccessful. The history of control efforts has most often involved the use of broad-spectrum pesticides in agriculture and urban settings, with active ingredients shifting as regulatory standards have changed. More recent conservation efforts in the Galapagos and Hawaii have employed the toxicant hydramethylnon in attempts to eradicate the little fire ant and the Argentine ant from natural areas. Results indicate that at least one effort in the Galapagos may have been successful against the little fire ant, but on experimental plots in Hawaii eradication of the Argentine ant has failed. The present focus in Hawaii has therefore shifted to strategies for suppressing further invasion, and this has met with moderate success. We report these results here. Alternative approaches, including the disruptive use of juvenile growth hormones and semi-chemical pheromones, have been limited. Implemented alone, these techniques generally have not shown promise of achieving eradication. This leaves the state of invasive ant control unresolved, especially because the current techniques available are appropriate only in certain situations. As a new campaign is being undertaken against the Argentine ant in New Zealand, and as problematic tramp species in general continue to expand their ranges, the need for renewed investigations into ant eradication techniques is critical. We discuss briefly some novel integrative approaches that might be attempted.

The effectiveness of weeded and fenced ‘Conservation Management Areas’ as a means of maintaining the threatened biodiversity of mainland Mauritius

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Mauritian native ecosystems continue to be degraded by the action of alien plants and animals. Lack of management is not an option if Mauritius’ unique biodiversity is to be maintained. Weeding of alien plants and the fencing out of deer and pigs was first recommended for conservation in the 1930s. Ten weeded and fenced ‘Conservation Management Areas’ (CMAs) have been set up in a variety of ecosystem types. Predator control is also practised in some CMAs. The effects of management on native flora and fauna have been quantified in several upland CMAs. Consistent weeding and maintenance of fences appears to result in a spectacular regeneration of native flora. In the Brise Fer ‘Old Plot’, first weeded and fenced in 1987, a minimum of between 53% and 68% of native tree taxa are regenerating. Regeneration of

some taxa was probably prevented by mammals that cannot be excluded by conventional fences. The diversity of native seedlings and saplings is relatively low in a more recently managed part of Brise Fer and in the nearby Mare Longue CMA respectively. In the former this may be due to the fact that several deer were inadvertently fenced into the CMA for over two years. In the latter, rocks were not placed at the foot of the fence, thus allowing pigs to burrow into the plot. Native butterflies were on average 19 times more abundant in the surveyed CMAs than in non-managed areas while results for native birds were equivocal. In contrast, densities of some native snail groups were lower in CMAs. This may be due to the effect of persistent rat poisoning and the change in habitat after initial weeding. Current CMAs can be highly effective if the fencing is of a consistently suitable standard, and if any incursions of deer and pig are dealt with rapidly. Weeding methods may have to be modified to minimise non-target damage. Non-regenerating or negatively impacted species may have to be managed individually. An alternative or complement to this would be the use of predator-proof fences.

Preparation for the eradication of Norway rats (*Rattus norvegicus*) from Campbell Island, New Zealand

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Norway rats (*Rattus norvegicus*) have populated Campbell Island in the New Zealand subantarctic for nearly 200 years. During this time they, in combination with feral cats which have since died out, have had a devastating effect on the island's fauna, marooning several species of bird to the small rat-free islands around the coast and probably causing the extinction of several other undiscovered species. At 11,300 ha the attempt to eradicate rats from Campbell Island will be the largest ever undertaken. The island's size coupled with its location in the furious fifties (700 km south of the New Zealand mainland) renowned for their strong winds and frequent rainstorms, means the attempt will be stretching the boundaries of current technology. In order to make the eradication logistically feasible, the margin for error that has been built into all previous eradications has had to be significantly reduced. Instead of two bait drops totalling 12kg/ha as is usually used, Campbell will be done with a single drop, but with a 50% overlap to eliminate the risk of gaps, totalling 6 kg/ha. This technique was tested in 1999 with a 600ha field trial carried out on the island. Rhodamine dye showed that all the rats in the baited area ate bait and would therefore have been killed. While there is only 70 hours of bait dropping required and three helicopters will be used, the short daylight hours on Campbell during the winter and the predictably bad weather, mean that the project team must plan to be on the island for up to three months. Non-target issues are minimal, with the only priority species at direct risk being southern skuas (*Catharacta skua*), which fortunately are absent from the island until mid August. However if the drop is delayed not only will skuas be affected but so will the large colonies of mollymawks which nest at the north end of the island and present a real risk to the helicopters. The drop will be carried out in July - September 2001 with no follow-up until 2003. There will only be one attempt and we either succeed or fail.

Island quarantine – prevention is better than cure

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While there is currently an international focus on the eradication of introduced invasives (particularly rodents), it is easy to forget that usually the easiest, cheapest and often the only way to avoid the significant impacts that invasives can have on an island ecosystem, is to prevent them getting to the island in the first place. There are numerous examples of "near misses", where rodents in particular have made it onto islands or have only failed to do so by sheer luck. That these incidents did not result in the establishment of the predators can only be put down to good fortune. It is vital that in future, precautions are put into place that mean that we don't rely on luck to keep islands free of introduced species. To date, quarantine precautions have focussed largely on rodents, and they have been the flagship of the quarantine battle. This has been very productive as everyone hates rats and can understand/relate to the damage they can do on an island. However, with increased awareness and knowledge, it is apparent that other species can pose a greater, albeit not so obvious, risk. These include invertebrates, plants and even microorganisms. Standard precautions such as sealed containers work well for rodents but do little to prevent the introduction of a vast and ever increasing number of weed species and invertebrates. This risk is at a new level and relies heavily on the individual taking responsibility. Basic precautions such as scrubbing footwear and checking pockets are simple and can significantly reduce the risk, but are often overlooked. All visitors to islands (tourists, researchers, and managers) pose a quarantine risk, and a quarantine

plan must be practical for all the situations relevant to the specific islands. Currently there are significant resources being dedicated to trying to stop invasives, rodents in particular, getting established once they make it to an island. However, these contingencies are often expensive and are at best unreliable. Further research is required on the effectiveness of the various options (e.g. traps vs toxin), and also on the behaviour of rats reaching a new island.

The role of parasitoids in eradication or area-wide control of tephritid fruit flies in the Hawaiian Islands

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Koinobiont larval endoparasitoids (Hymenoptera: Braconidae: Opiinae) of tephritid fruit flies have been used with variable success rates in classical biological control, but have not previously been considered as useful adjuncts to eradication programmes. Successful eradication of tephritid flies from other Pacific Islands has been accomplished by utilisation of semiochemical-toxicant combinations (male annihilation) and/or the sterile insect technique (SIT). However, pilot projects designed to show feasibility of medfly (*Ceratitis capitata*) eradication on the Hawaiian island of Kauai failed because of the inability to achieve adequate overflooding ratios of sterile:wild males. Medfly population reduction sufficient to achieve suitable overflooding ratios is not possible with insecticides due to the location of populations in remote and environmentally sensitive areas. Population dynamics models demonstrate the synergistic effect of combined augmentative parasitoid releases with SIT. The release of new species or strains of parasitoids that are self-perpetuating and dispersing would be more cost-effective. The potential is demonstrated by *Fopius arisanus* from Asia, which causes over 95% egg mortality of Oriental fruit fly (*Bactrocera dorsalis*) in guava. Comparable levels of parasitism for melon fly (*B. cucurbitae*) in cucurbits might make eradication in Hawaii feasible.

Response of forest birds to rat eradication on Kapiti Island, New Zealand

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Five-minute bird counts were used to determine whether the eradication of Pacific rats or kiore (*Rattus exulans*) and Norway rats (*R. norvegicus*) from Kapiti Island in 1996 had any measurable impact on the diurnal forest bird community. Counts undertaken quarterly from April 1999 to January 2001 were compared with counts undertaken using the same methodology from April 1991 to January 1994. At least four species appear to have increased since rat eradication: red-crowned parakeet (*Cyanoramphus novaeseelandiae*), robin (*Petroica australis*), saddleback (*Philesturnus carunculatus*), and bellbird (*Anthornis melanura*). None of the 15 species investigated showed evidence of a consistent decline since rat eradication, although two (tui (*Prothemadera novaeseelandiae*) and tomtit (*Petroica macrocephala*)) were less conspicuous than in 1991-1994 in four of the eight count sessions completed to date. Weka (*Gallirallus australis*) were adversely affected by the rat poisoning operation, but had recovered to pre-eradication levels by 1999. The present series of counts will be completed in January 2002.

Sustained control of feral goats in Egmont National Park, New Zealand

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Egmont National Park (33 540 ha) is a forested mountain 'island' surrounded by a 'sea' of farmland. Feral goats have been present in the Park since c. 1910. Control efforts have been ongoing since 1925, making it one of the longest-running sustained vertebrate pest control operations in the world. Although helicopter-based hunting has proven effective at reducing goats above timberline, most of the Park is forested and the primary method of control in this habitat has been ground-based hunting with dogs. We used indices of hunting effort (days hunted) and goat population density (goats killed/days hunted), to investigate trends in the goat population in response to management during the period 1961-1999. Annual hunting effort generally increased over the period 1961-1986 but, following a change in the management organisation in 1987, has since declined. Goat density was highest in the earliest years of control (c. seven goats killed/day) and steadily declined until 1987 (0.8 goats killed/day). Post-1987 the population has been maintained at low densities (<2 goats killed/day). The likely consequences of alternative strategies for allocating hunting effort on goat densities will be discussed.

Pacific rats: their impacts on two small seabird species in the Hen and Chickens Islands, New Zealand

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The Hen and Chicken Islands support introduced Pacific rat (*Rattus exulans*) populations and also remnant populations of two small burrow-nesting seabirds, the summer breeding Pycroft's petrel (*Pterodroma pycrofti*) and the winter-nesting little shearwater (*Puffinus assimilis haurakiensis*). The sequential eradication of kiore from the larger Chickens in the 1990s provided an opportunity to measure the responses of these seabirds to kiore removal. The following hypotheses were tested: (1) Breeding success of the two seabird species is not limited by kiore presence, (2) breeding success is not limited by the presence of tuatara (*Sphenodon punctatus*) an endemic predatory reptile, (3) the two seabird species are not in competition with each other. Two study islands were used: Coppermine and Lady Alice Island. Study burrows were checked early and late in the seasons to determine breeding success. Success was significantly lower when the study islands contained kiore: little shearwaters averaged a 16% breeding success in the presence of kiore and 61% in the absence of kiore, while Pycroft's petrels averaged a 33% breeding success in the presence of kiore and 57% in the absence of kiore. Contemporaneous data for the two islands enabled other factors such as food supply and heavy rainfall to be eliminated as confounding variables. For example, the lowest breeding successes of little shearwater (5%) occurred in a kiore-present scenario for two years on Coppermine, but in the same two years productivity was high on kiore-free Lady Alice Island. Similarly, for Pycroft's petrels, the lowest years of breeding success were in kiore-present scenarios, but in the same years there was significantly higher productivity in the kiore-free scenarios. The presence of tuatara in burrows did not significantly influence the breeding success of these seabirds, at least in a post-kiore scenario. However, in burrows used by both species of seabirds, late-fledging little shearwaters disrupted the nesting of Pycroft's petrels, causing some pairs to be displaced to other burrows or abandon nesting for the season. Currently, the effects of this competition on Pycroft's petrel are small and more than compensated by their increased productivity following kiore removal. In conclusion, these findings demonstrate clear negative impacts of kiore on small seabird productivity. They are consistent with the recorded decline in seabird populations on the Hen and Chickens Islands during the 20th century. Count data from Lady Alice Island from 1992 to 2000 indicate that this population decline has been halted and apparently reversed.

Seabird re-colonisation after cat eradication on equatorial Jarvis, Howland, and Baker Islands, USA, Central Pacific

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In 1990, the last feral cat (*Felis catus*) was removed from Jarvis Island National Wildlife Refuge in the Central Pacific Ocean. Cats were removed from two other equatorial islands: Baker Island in the 1960s and Howland Island in 1986. Introduced during the 1930s, cats had extirpated some species of terns, small procellariids, Pacific (*Rattus exulans*) and Norway (*R. norvegicus*) rats from Jarvis, Howland and Baker Islands. After cat and rat eradication, previously extirpated seabirds (blue-gray noddies (*Procelsterna cerulea*), Christmas and Audubon's shearwaters (*Puffinus nativitatis* and *P. lherminieri*) and white-throated storm-petrels (*Nesofregatta fuliginosa*)), have re-colonised Jarvis Island. Baker Island has been re-colonised by wedge-tailed shearwaters (*P. pacificus*) and hundreds of thousands of birds that moved from Howland Island. Small tern populations are returning to Howland Island as well as increased numbers of wintering shorebirds. Even though the predation-free period has been longer for Howland and Baker than Jarvis Island, fewer new species have re-colonised them, probably because of the great distance to other colonies that could serve as a source.

Direct and indirect effects of house mice on declining populations of a small seabird, the ash storm-petrel (*Oceanodroma homochroa*), on Southeast Farallon Island, California, USA

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There is concern over severe population decline of the ash storm-petrel (*Oceanodroma homochroa*) on Southeast Farallon Island (SEFI), California (37°N 123°W). Evidence from a mark-recapture analysis suggests that a primary cause of this decline is increased predation on this species, whose main predators include expanding populations of western gulls (*Larus occidentalis*) and migrant burrowing owls (*Athene cunicularia*). There is evidence that the introduced house mouse (*Mus musculus*) may occasionally prey upon ash storm-petrel eggs and chicks, although the extent of this is unknown. Owl arrival in the fall coincides with the peak mouse population, but with decreasing food supplies in the late winter, the mouse population reaches a low point. When this occurs, the wintering owls lose a primary food source and may shift their diet from house mice to ash storm-petrels, which arrive to SEFI in early spring to begin their breeding cycle. Thus, the indirect effect of mouse presence on ash storm-petrel populations, through burrowing owls, is perhaps more severe than the direct effects. The U.S. Fish and Wildlife Service is currently considering a proposal to remove house mice from the island. Justification of this action will rest heavily on documentation of adverse affects of mouse presence on the natural ecology of SEFI. Before eradication plans are implemented, all factors, both direct and indirect, must be considered.

Managing pest mammals at near-zero densities at sites on the New Zealand mainland

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Six "Mainland Island" projects are being undertaken by the Department of Conservation at sites on the North and South Islands of New Zealand. A feature of these projects is the range of pests targeted for control and the relatively low pest densities achieved as a result of pest control operations. These early results are significant in that they suggest that effectively managing the impacts of mammalian carnivores and herbivores is achievable on the mainland as well as on offshore islands. The challenge now is to develop more efficient pest control regimes so that conservation outcomes may be sustained. Better targeting and timing of pest control and more effectively controlling pest re-invasion rates will result in further advances in our capacity to conserve native biodiversity. In view of the urgency in implementing more effective conservation programmes to arrest further declines, and recognising our inability to predict ecological outcomes from intensive, multi-pest control programmes, an adaptive experimental management approach has been proposed to enhance our understanding of pest impacts; ecological responses are enhanced as part of the management process.

Control of feral goats (*Capra hircus*) on Santa Catalina Island, California, USA

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Santa Catalina Island, a mountainous, 194 km² island is the third largest of the eight California Channel islands. In addition to numerous endemic species, it also has a resident human population of approximately 4000 people and nearly 1,000,000 visitors per year. The Santa Catalina Island Conservancy owns and manages 88% of the island with a primary goal of natural resource protection while still allowing appropriate public access. Among Catalina's non-native mammal species are feral goats (*Capra hircus*) which were well established by the mid 1800s and may have reached a population high of 30,000 in the 1930s. Impacts by goats on natural resources have been severe, including destruction of endemic plant species and island plant communities, increased erosion, and soil compaction. Although sport hunters and island resource managers removed large numbers of goats throughout the years, sizeable populations remained until the 1990s. From 1990 to 1994, ground and aerial hunting removed over 7700 goats from the island, but due to lack of funding the programme was stopped after approximately 95% of the goats were removed. In 1996, a new effort was initiated to remove all goats from the west end of the island. By early 1998, the only goats known to be in this area had telemetry tracking collars attached and the programme was expanded to include the rest of the island. During the next

six months over 600 goats were removed by hunting. Following a community forum in January 1999, an outside animal welfare organisation submitted a live capture proposal. The Conservancy Board elected to suspend hunting to try the proposal. In the fall of 1999, 121 goats were captured and shipped off the island. In January 2000, permission to resume hunting was granted and 66 goats were removed. Shortly thereafter, another live capture proposal was submitted and the Board elected to follow a live capture programme for all remaining goats on the island (estimated 25-30). By the start of 2001, all uncollared goats should be removed and we hope to remove the collared goats by the end of 2001, thus reaching the objective of zero goats.

Control of the invasive exotic yellow crazy ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean

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The exotic invasive ant *Anoplolepis gracilipes* was accidentally introduced to Christmas Island between 1915 and 1934. It remained in relatively low numbers until 1988 when an isolated infestation of very high densities of ants was discovered. In 1998 several more infestations were found. Infestations range in size from less than 1 ha to over 100 ha. Currently about 1400 ha or 14% of the forest is infested. In areas of infestation *A. gracilipes* forms extensive multi-queened supercolonies where high densities of workers are sustained on the forest floor and on most plant surfaces, including rainforest canopy species. These infestations have serious impacts on the integrity of the rainforest ecosystem of Christmas Island by eliminating the dominant red crab (*Gecarcoidea natalis*) from infested areas. The red crabs control seedling recruitment and litter breakdown, and their removal results in a rapid transformation of the rainforest ecosystem in terms of habitat structure, species composition, and ecosystem processes. The ant infestations also pose a serious threat to endangered species of birds and reptiles. Parks Australia has developed a methodology for a chemical control programme. The key requirements of this programme are that the bait be: (a) highly attractive to ants such that they monopolise the baits, (b) slow acting so that maximum transfer of bait occurs among individuals, (c) effective over a wide range of concentrations, and (d) not detrimental to non-target species. A number of chemicals and attractants were tested and the most effective bait was fipronil in a fish protein base. Widespread distribution at a rate of 0.5 grams active ingredient per hectare on half hectare plots demonstrated that this bait was effective in reducing ant densities, wiped out ant nests, and had no detectable non-target impacts. Larger-scale baiting is currently underway. While complete eradication of *A. gracilipes* from Christmas Island is probably an impossible task, initial baiting trials have shown that it may be possible to reduce ant densities to levels where red crabs and ants can coexist. A concurrent research programme is being undertaken along with the control program in order to provide better information for the management of this issue.

Preventing rat introductions to the Pribilof Islands, Alaska, USA

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The Pribilof Islands have about three million nesting seabirds, a million northern fur seals, an endemic shrew, and other wildlife. Rat introduction would greatly reduce bird and shrew populations and might transfer diseases to humans and wildlife. The islands have been inhabited since 1786 and, although the lack of harbours impeded rodent introduction, house mice became established on St. Paul in 1872. In the early 1990s harbours were constructed on both St. George and St. Paul Islands. A boom of commercial fisheries soon followed and eventual rat introductions seemed a certainty. With the objective of keeping the Pribilofs rat free, a prevention programme was begun in 1993 based on cooperation with local communities, government agencies, and industry. The programme consists of maintaining trap and poison stations, community education, local shipwreck response capabilities, outreach to vessels to make them rat free, and regulations. Over 450,000 trap nights have passed and several rats have been killed on the St. Paul docks, but there is no evidence of rats becoming established anywhere in the Pribilof Islands. Improved design of preventive stations has decreased maintenance needs. Snap traps have been more effective than poisons, but have caused minor loss to non-target species. Both techniques are recommended. The local communities are taking increasing ownership in the programme and it appears fewer ships using the Pribilofs carry rats. Unless there is a major advancement in rodent removal technology, the prevention programme will have to be maintained forever. It is too early to be certain that the program is adequate to protect the Pribilof Islands, but as each rat-free year passes, hopes are rising.

Ecological restoration of islands in Breaksea Sound, Fiordland, New Zealand

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New Zealand has long been renowned internationally for its innovative conservation strategies. Translocation as a conservation management technique was pioneered in Fiordland between 1894 and 1900 when Richard Henry undertook 700 transfers of a range of vulnerable birds such as kakapo (*Strigops habroptilus*) and kiwi (*Apteryx australis*) to Resolution Island (and smaller adjacent islands) from nearby mainland sites in Breaksea and Dusky Sounds. This far-sighted project was abandoned when introduced stoats reached the area. Biological surveys of islands in Breaksea Sound in the 1970s resulted in an ambitious island restoration project in which Norway rats (*Rattus norvegicus*) were eradicated from bush-clad Hawea Island (9 ha) in 1986 and rugged Breaksea Island (170 ha) in 1988. Before poisoning on Breaksea Island, South Island robins (*Petroica australis*) were transferred to Hawea Island as a precautionary measure. The resultant population is the densest recorded, and they have even dispersed across 300 m of open water to neighbouring Wairaki Island (3 ha). South Island saddlebacks (*Philesturnus carunculatus*) were released onto Breaksea Island in 1992 with similar success and yellowheads (*Mohoua ochrocephala*) are confirmed breeding following an experimental transfer from the mainland in 1995. We undertook some of the first experimental translocations of lizards and invertebrates: Fiordland skinks (*Oligosoma acrinasum*) being released onto Hawea Island in 1988, and knobbed weevils (*Hadramphus stilbocarpae*) and flax weevils (*Anagotus fairburnii*) transferred to Breaksea Island in 1991. A programme to monitor ecological change, using several key, indicator species of flora and fauna, was set up before poisoning to document the benefits of eradicating rodent pests. Natural dispersal of Fiordland skinks onto Breaksea Island from a nearby rock stack was confirmed within two years, and recovery and/or natural dispersal of vulnerable flightless mega-weevils on islands in Breaksea Sound provide further examples of the dynamic ecomarine interface. Despite a lack of funding, monitoring has been maintained, albeit at a reduced level, by using eco-tourism to provide the essential but expensive logistic support and field assistance needed to undertake research in such a remote location.