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Department of Horticultural Science
University of Minnesota, St.Paul, MN

Restoration of New Zealand's Coastal Islands

Cindy Fritchman

A significant part of New Zealand's biological heritage resides on its offshore islands (Towns *et al.* 1990). With the arrival of Polynesians approximately 1000 years ago and Europeans about 225 years ago, an ecological collapse began as a result of introduced plant and animal species (Towns and Ballantine 1993, Llyod and Powlsland 1994). Plant introductions have averaged 11 species per year since European settlement (Atkinson and Cameron 1993). Introduced predators and browsing mammals have resulted in a 48% loss of the fauna in the last 200 years (Towns and Ballantine 1993). These introductions, in addition to human activity, have resulted in the extinction of many native species.

The remaining native island biota still contribute significantly to the overall biodiversity of New Zealand. The islands provide a unique opportunity for protecting lowland and coastal communities from the influence of humans and their introduced animals that is not possible on the mainland (Towns *et al.* 1990). The mainland is heavily influenced by the large human population and therefore does not provide appropriate locations for restoration. Restoration efforts on coastal islands may ultimately provide useful information that may be applied to small restorations on the mainland in the future. Although coastal islands are often easier to restore because much of the biological wealth has been preserved, human alteration on islands can be as devastating as on the mainland (Towns and Ballantine 1993, Daugherty *et al.* 1990).

New Zealand includes more than 600 islands, which spans a land area of 268,000 km2 in climatic regions that range from subtropical to subantartic (Towns and Ballantine 1993). The ecosystem consisted mostly of lowland forests and wetlands (Atkinson and Cameron 1993). The convergence of temperate and tropical zones leads to high diversities of communities throughout New Zealand resulting in a very unique ecosystem. These communities vary with isolation and island size (Towns and Ballantine 1993). Before human introductions, New Zealand lacked all terrestrial mammals other than bats (Towns and Ballantine 1993). New Zealand supports an extraordinary high proportion of the world's penguin species and also of albatrosses, petrels, shearwaters, and prions (Daugherty *et al.* 1990, Towns and Ballantine 1993). The region also includes high densities and diversity of flightless birds, seabirds, and reptiles (Towns and Ballantine 1993).

Because of human activity, the ecosystem has been drastically altered and 400 species are threatened with extinction (Atkinson and Cameron 1993). The forested area has been reduced from 78% to 23% of the land area because of clear cutting for development and farming (Atkinson and Cameron 1993). Forty-five species of land birds, 40% of the bird fauna, and 43% of frog fauna has been lost (Atkinson and Cameron 1993). Introduced species such as possums feed on native birds' eggs, reducing the population of native birds. The introduction of ship rats on islands has dramatically reduced plant and animal populations. These animals and others have threatened the natural system both on the mainland and coastal islands.

The government of New Zealand has taken the initiative in restoring these islands. The New Zealand Department of Conservation has been given the responsibility of restoring the coastal islands to their pre-human state. This paper will review the three main restoration procedures being used: eradication, translocation, and revegetation and provide a critique of the restoration program to be implemented by the New Zealand Department of Conservation. Because this restoration program is large and involving hundreds of islands, it is impossible to discuss every restoration in this paper. Instead, an example of each procedure (eradication, translocation, and revegetation) will be given to understand this restoration program.

Eradication

Eradication is defined as the permanent removal of a species followed by management to insure recolonization does not occur (Parkes 1990). Two general principles should govern management of exotic species: the introduction of new exotic species should be limited and exotic species present on the islands should be eradicated (Parkes 1990). The first step in to decide which animal and plants should be eradicated from which islands. Urgent cases must be implemented before easily eradicated species (Parkes 1990). The Department of Conservation found that it was not necessary to eradicate all exotic biota. Norfolk Pines on Kaoul Island and blackbirds on Kapiti Island are not endangering any native species (Parkes 1990). Secondly, new exotic species must be prevented from entering islands (Parkes 1990). Upgrading quarantine regulations is the main way exotic species entry is controlled. Lastly, island managers need to record and report any attempts to eradicate plants or animals from the islands so that assessment of removal strategies can be made (Parkes 1990).

Cuvier Island Eradication Example:

Cuvier Island was formed 25 km off mainland North Island and contains primarily mainland flora and fauna (Mansfield and Towns 1997). Records from Cuvier Island reveal that Cuvier's biota included large flightless crickets, many species of land snail, tuatara, at least ten species of lizards, at least eight species of burrowing seabirds, landbirds, and a cover of lush evergreen coastal broadleaf forest (Mansfield and Towns 1997).

Pacific rats (*Rattus exulans*) were the first exotic to invade Cuvier Island in the early nineteenth century. Human use of the island as a lighthouse reserve resulted in a "biological mess" by 1950 (Mansfield and Towns 1997). Cattle, sheep, and wild goats reduced the dense, broadleaf forest to an open woodland without an understory. Predation by cats eliminated several forest birds. Only two species of burrowing seabirds and seven tuatara adults remained on the island.

Restoration began almost forty years ago with the eradication of goats and then feral and domestic cats. These mammals have been banned from the island since 1970. Eradication of these animals is easy because of their size and ease of capture. The Pacific rats are more difficult to eradicate because of their large populations and the habitat in which they live. The introduction of second-generation rodenticide that minimizes bait shyness was sown by helicopter in 1993. Pacific rats were successfully eradicated from Cuvier Island (Mansfield and Towns 1997). With these species eradicated from the island, natural regeneration is now possible.

Translocation

Translocation is defined as the movement of living organisms from one area with free release in another (Young 1990). Before translocation efforts can begin, precise objectives and a definite timetable must be developed. Before any translocation occurs, the impact on the species must be assessed, both during and after the translocation. The genetic make-up of the possible source biota and its relationship to the new habitat and geographic region must be determined. Certainty about the identity of the animals and plants to be translocated is very important. Quarantines must also be implemented to ensure that diseases are not transferred, and that animals and plants are clean (Young 1990). Translocation of threatened species to coastal islands is necessary to preserve and increase remaining populations.

Kakapo Translocation Example

The kakapo (*Strigops habrotilus*) is a flightless, nocturnal parrot, endemic to New Zealand (Lloyd and Powlesland 1994). It is the largest parrot in the world. Kakapo were widely spread throughout the mainland before Polynesians populated New Zealand. Since then, predation and competition by introduced animals and deforestation have reduced the kakapo to 50 individuals.

Attempts to preserve the kakapo have relied on translocation of wild kakapo to coastal islands free of predators. Almost the entire population of kakapo has been translocated to four coastal islands (Maud, Little Barrier, Codfish, and Mana Islands). Before translocating the kakapo, it was necessary to select and prepare suitable islands (Lloyd and Powlesland 1994). The islands needed to be free of predators and competitors, and have a suitable habitat, climate, and vegetation. Transportion occurred in the winter or early spring to avoid moving parrots during breeding. The kakapo were located by trained dogs and caught by hand. Transmitters were mounted on the birds' backs and they were released until the day of translocation. The transportation portion of the translocation was usually less than 12 hours long. Minimizing the length of transit reduced shock and stress on the kakapo. Supplementary food was given after release in order to acclimatize the kakapo to their new environment. Sixty three to 85% of the 65 translocated birds had survived in 1992. None of the birds had reproduced by 1992 (Lloyd and Powlesland 1994).

Some people believe the translocation was successful because the translocation has increased the population of kakapo. Others consider it unsuccessful because the kakapo are not yet a self-sustaining population. Translocations of kakapo could be more successful if the environment they are moved to is more like their native environment. Later translocations were more successful due to the growth of the forests on the island (growth of forest resulting from removal of predators and browsing animals). Also, the impact of transit should be studied more thoroughly. More research should be conducted to obtain a higher success rate.

Revegetation

Revegetation is defined as active intervention and management to restore vegetation communities formerly present (Timmins 1990). Revegetation requires a lot of money, time, and people, so it should be restricted to severely modified islands. Natural revegetation should be

promoted when possible. Seed dispersal occur over short distances between islands, promoting natural revegetation. However, on severely modified islands or distant islands, revegetation should be implemented.

Tiritiri Matangi Island Revegetation Example

Tiritiri Matangi Island has been classified as a recreation reserve open to public access as part of Hauraki Gulf Maritime Park (Mansfield and Towns 1997). Previously, it had been used as a government lighthouse settlement and used for farming. Almost all the original coastal broadleaf forest had been destroyed (Mansfield and Towns 1997). The Supporters of Tiritiri Matangi Island, under supervision of the Department of Conservation, recruited volunteers from the local community to create a habitat for native fauna. First, all farm stock and Pacific rats were eradicated from the island. Then the Supporters built a nursery facility on the island to raise 240,000 native tress and shrubs. The seeds and cuttings were collected locally on the island. These plantings and natural revegetation have contributed to the development of forest over much of the island. An assessment of the success of this revegetation effort was not noted.

Conclusion

Today about 300 islands are protected, half of them as nature reserves with little public access (Towns and Ballantine 1993). Islands are now often the stronghold for plant, invertebrate, lizard, bird and bat species that are declining on the mainland. Restorations are still occurring on the islands and with each, something new is learned.

Each procedure (eradication, translocation, and revegetation) has helped to restore the islands toward the goal of a pre-human state. Eradication of exotic plant species, farm animals, and ship rats seems to be the most successful procedure. With eradication, native plant and animal species can reestablish on the coastal islands; thus, saving many species from extinction. More research is needed for translocations to become more successful, particularly regarding the impacts translocation will have on the species and requiring the new environment to be as close to the original environment as possible. Both of these efforts will help the translocations be more successful and reduce the loss of species during translocations. Natural revegetation should be used when possible. Revegetation of plant species on coastal islands will most likely provide important information for future restorations. With successful revegetation on islands, areas on the mainland can be attempted as well.

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