Effects of intervention on the royal albatross population at Taiaroa Head, Otago, 1937–2001

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ABSTRACT

Northern royal albatross *(Diomedea sanfordi),* classified by the IUCN as endangered, breed at a small publicly viewed colony at Taiaroa Head on the New Zealand mainland. The colony has been monitored since the first successfully reared chick in 1937/38, and has been security-fenced since 1964. Since 1951 various programmes to control the effects of introduced predators (cats, dogs, mustelids, and more recently blowflies) have been maintained. From a 100% immigrant breeding population in 1938, the proportion of breeding immigrants has declined to 8% today, with the balance having been bred at the colony. For the past 30 years various management practices have been used to maintain or improve productivity. Methods developed include the use of dummy eggs, hatching in an incubator to avoid fly strike, fostering of eggs and chicks, hand rearing, recovery of birds to the colony after a failed first flight into the Otago Harbour. The hatching rate is 60–62%. Without management intervention, the mean fledging would have been 54% of eggs hatched rather than the 74% achieved. A mean 75% of non-managed fledged chicks survived to the age of 5 years (pre-breeding), but only 60% of managed chicks survived over the same period. With significant climatic stress and introduced blowfly in the past 12 years, management intervention at the egg and chick stage (up to 100% of nests in some years) has ensured productivity was raised to 72% from a probable 33% if those birds managed had been allowed to die. The cumulative effect of significant management interventions has ensured that the present population of the colony is 109 individuals instead of the probable 72 individuals, if managed birds had been allowed to perish and their subsequent progeny had not been added to the population.

Keywords: royal albatross, population, intervention, productivity, Taiaroa Head, Otago, New Zealand.

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1. Introduction

The northern royal albatross *(Diomedea sanfordi)* breeds at a small publicly viewed colony at Taiaroa Head, Otago Peninsula, Dunedin (Nomenclature follows Nunn et al. 1996; Robertson & Nunn 1998; Croxall & Gales 1998). This mainland colony accounts for some 0.5% of the total breeding population of this taxa, with the main populations breeding in the Chatham Islands group. The colony attempted to establish itself on the Otago Peninsula between about 1900 and 1936. As a result of the protection given by L. Richdale in 1937/38, the first chick was successfully fledged in 1938. Various protective measures were progressively introduced after 1945 and the reserve was security-fenced in 1964. Permanent management staff have been attached to the colony since 1951 by the Department of Conservation and its predecessor the NZ Wildlife Service.

The banding of birds at Taiaroa Head for individual identification was introduced by Richdale and has been continued to the present. Through monitoring, this has ensured that a reliable record has been maintained of bird presence, breeding attempts, progeny and immigrants at the colony (Robertson & Richdale 1993; Robertson 1993a, 1993b). Since 1951 there have been various management trapping programmes to control or eradicate introduced predators. The security fence has ensured reasonable control over human and canine access. Trapping has been aimed primarily at cats and mustelids, and more recently, at the introduced blowfly *Lucilia sericata* which is associated with generally warmer and drier climatic conditions (Robertson 1998). It is not possible to determine what direct effect these control operations have had on the albatross population. However, more potential fledglings have died from blowfly/heat effects since 1987 than for all other forms of predation during the life of the colony.

There have been significant changes to the nesting habitat of this taxon at its Chatham Island breeding colonies during the 1980s. These changes have significantly reduced nesting success, causing a predicted decline in the total population of some 30% within one generation without compensating changes in habitat, breeding or productivity. At the same time there has been a marked drying of habitat both at Taiaroa Head and the Chatham Islands. High temperature, low humidity and lack of wind have been proven to place incubating birds and their eggs at risk, especially at Taiaroa Head, during incubation and hatching. The general factors influencing the breeding performance of the northern royal albatross are summarised in Robertson (1998). The northern royal albatross taxon has been classified as endangered by the IUCN, based on Croxall & Gales (1998) and most recently in Birdlife International (2000).

Although tiny, the Taiaroa Head colony is important not only because it allows the general public to develop an appreciation for albatrosses, but because of the continued monitoring and management of the colony for over 60 years. The results of this monitoring and management have allowed the identification of factors, which would be difficult or impossible to determine at oceanic breeding sites, that affect albatross nesting behaviour and breeding performance (Robertson 1998).

This review considers the following questions:

1. What significant management methods of intervention (such as hand rearing, fostering, etc.) during nesting have been used to increase the productivity of the colony?
2. Had these interventions not occurred, what effects would such absence of intervention have had on the estimated annual live population of the colony?
3. Based on identifiable birds, what has been the estimated total annual live population of northern royal albatross associated with or using the Taiaroa Head Nature Reserve from 1936/37 to the 2000/01 breeding season?

2. Intervention methods

A broad range of activities have been implemented at various times to answer specific problems. Peat & Robertson (1994) indicate some of the combinations used during one summer.

1. Direct protection

The first chick fledged in the colony after Richdale spent an extensive part of its incubation and growing period camped near the nest to prevent attack or depredation. Previous eggs had been stolen as far back as the 1920s and chicks had been killed by predator attack or humans throwing stones. The security fence and the controlled public visiting to an observatory are the more modern extensions of such direct management protection. The closing of the colony to land-based tourism during the pre-egg and laying period is a further extension of this process to reduce disturbance, as is the recent tinting of the windows in the observatory to reduce visual disturbance of the birds throughout the year (Robertson 1998).

2. Dummy eggs

Dummy eggs were introduced as a management tool about 1969. Firstly they were designed as a training tool for pairs who consistently broke their eggs (the male of one pair had broken more than 10 eggs in successive years). After a season on a dummy egg the pair operated normally thereafter. To be effective, the dummies need to be inserted as soon as the egg is broken or shows signs of breaking (weeping of an addled egg). Subsequently they were used to not only train birds in incubation, but to hold pairs at the nest to provide natural foster parents when needed (see below).

3. Hand rearing

Robertson & Wright (1973) reported on early hand rearing attempts with chicks who had one or both parents not returning to feed (in most cases seemingly dead). The techniques have been developed to ensure as natural a food supply as possible is maintained, using fish, squid, proventricular oil (from sooty shearwater *Puffinus griseus*), fresh water and various vitamin and mineral supplements. As well as the direct maintenance of food through to fledging, short-term supplementation has been used for stressed (dehydrated) parents and chicks who have been sitting for extended periods awaiting a missing mate or parent, respectively.

4. Foster parenting

This has been used as a management tool with both short- and long-term fostering of eggs and/or chicks when other methods have not been feasible. Fostering of eggs is used where an egg is deserted and can be immediately fostered to a failed, but dummy egg, sitting pair. Alternatively, the egg may be held for a period in an incubator before being fostered, or hatched in an incubator before fostering the young chick (see below). During the guard stage of chick rearing (approximately the first 30–40 days from hatching) it is possible to replace a dummy egg with quite a large chick without rejection by foster parents. This ability has also been exploited in the short term during temporary emergencies, or for the remaining development of the chick.

In some years in the 1990s during periods with significant losses or desertions of sitting parents, due to heat stress or other causes, there have been occasional short periods when there have not been enough sitting parents to cope with the number of chicks in the colony. In this circumstance the weakest chicks have been fostered for short periods to parents of larger chicks to enable the natural begging and feeding process to be developed and allow the transfer of any intestinal flora or enzymes needed for the development of proper digestion.

5. Artificial incubation

With the use of an incubator from the mid 1990s it has been possible to control the risk of fly strike, especially for those eggs which are taking more than the mean of 3 days to hatch (maximum 6 days). Fly strike is most prevalent in times of high temperature, low wind, low humidity and generally dry conditions. Apart from fly strike, eggs are prone to having the membranes dry out, thus trapping the chick. These conditions have been more regular during the 1990s, and especially in strong El Niño conditions. The incubator has also been used for the successful incubation and hatching of an egg which had been punctured by the parent at laying (hole patched), before being returned to the parents for rearing of the chick. In extreme climatic conditions the incubator is an essential management tool for precautionary use to prevent fly strike while the chick is hatching. Its use prevents the need for extensive efforts to remove live maggots, which can take many hours and is often unsuccessful.

6. Treatment of chicks

As referred to above, chicks have been treated by the careful removal of maggots (white and only 1 mm long), but this is a time-consuming process and must be undertaken early, before maggots enter the body cavities, to be successful. Treatment of 'bronchial' infections has been undertaken under veterinary guidance using various antibiotics as a last resort.

7. Microhabitat manipulation

At times of high temperature (over 50ºC and a regular range of 30ºC), low humidity (below 40%), and little wind, the sitting adults are prone to heat stress and some have died when the lack of wind prevented escape to sea. A short-term palliative is the fog spraying of water over the sitting bird and the surrounding vegetation to raise humidity and reduce temperature through evaporation. In some recent years a temporary 'irrigation' system has provided sprayers at individual nests, and fire brigade hosing equipment was used before the localised system was developed. Some nests are in habitat where there is little soil below the nest or in the nest structure. Experimental use of water spraying in the nest seems to have prevented drying out problems in the egg during incubation, and especially at hatching, in extremely dry climatic conditions.

8. Predator control

The control of mammalian predators has been an ongoing process primarily achieved by various forms of trapping. Blowfly control is primarily reliant on a colony-wide coverage of substantial fly-drum traps, backed up by small traps close to the nest during hatching. The testing of various herbs, naturally woven into the nest by the parents as nesting material, seems to indicate that fresh mint is the most effective in repelling flies at about the hatching period. Daily provision of fresh material seems to be most effective.

9. Rescue after failed first flight(s)

A small proportion of the chicks get into local difficulties during their first flight and are washed ashore at Aramoana beach or are found further into the harbour with no way of flying out. Where the bird is alive, recoverable and not harmed (wing breakage) they are returned to the colony to try again in their own time. This is dependent on the public reporting of such birds in difficulty.

3. Results

For many of the practices referred to above, there is no practical method of determining whether they had a direct effect on the survival of an individual egg or chick. These practices fall into the category of preventative management required to reduce the risk of something more serious occurring. In some years, without some preventative intervention, there is an increased probability of more serious intervention being required at a later stage, or alternatively without intervention, an acceptance that birds which might survive with management will be allowed to perish.

In addressing this review I have considered any egg or chick which has had significant hand rearing (caused by a loss of parent), has been foster-parented either at the egg or chick stage, has spent an extended period in the incubator, including being hatched there, or as a fledgling has been recovered from the harbour after a failed first flight, as all being in categories where they would have been dead should the management intervention not have occurred. The resultant 'ghosts' would not have participated further in the development and behaviour of the colony, nor would any subsequent progeny which resulted from their breeding.

Initially, the colony was formed from immigrants who were primarily bred at the colonies in the Chatham Islands. Since 1938, a growing proportion of the birds associated with the colony (juvenile, adolescent, adult and breeding adult) have been bred at Taiaroa Head. Though the number of immigrants associated with the colony has now declined to about 8% of the population, the continued immigration provides a relatively regular underpinning of the population. Not all immigrants arriving remain to enter the local breeding population. During the 1990s this inflow has been markedly reduced as a result of poor productivity at the Chatham Islands' colonies.

The greatest biological benefit to the colony has been the very high survival rate of young royal albatross, with 60–80% of them surviving to the age of 5 years from most cohorts. It is possible therefore, to assess the likely total population which is associated with the colony. In the calculations made here, all birds are assumed to have returned by the age of 5 years and 80% of those younger than 5 years are assumed to be alive in any year. With a biennial species there will always be part of the breeding population absent (those who successfully raised chicks in the previous year). For ease of presentation these birds are all considered to be alive, though the normal annual mortality of adults is about 4–6% (Robertson 1993a, 1998).

Figure 1 summarises the probable population size of marked birds associated with the colony and the effect on the total available population, should all 'ghosts' (according to the criteria above) be removed.

The mean hatching rate of all eggs since 1936/37 has been 62%, but this is reduced to 60% if significant egg manipulations in the incubator are removed. Without the management interventions detailed above, only 54% of the hatched chicks would have survived to fledging. The result with significant management intervention is 74%, meaning that during the life of the colony some 20% of all chicks fledging have been 'ghosts'.

Significantly, the fitness of the bird to enter into the population, managed or not, must be greatly determined by its ability to survive to breeding age and develop the ability to feed itself and any subsequent progeny. Therefore it is of interest to find that while 75% of non-managed progeny survive to the age of 5 years, only 60% of the 'ghosts' survive to the same age. The most successful managed progeny were those fostered to natural parents, with a 75% survival, while 71% of those recovered from the harbour survived to 5 years. Those progeny which had the highest level of manual intervention (hand rearing, or using the incubator, veterinary intervention) had a 50% survival to 5 years. This group, however, often included birds closest to death, and any intervention methods used (often being developed by trial and error during the intervention process) regularly had to be undertaken in emergency conditions, and with a wider range of intervention procedures.

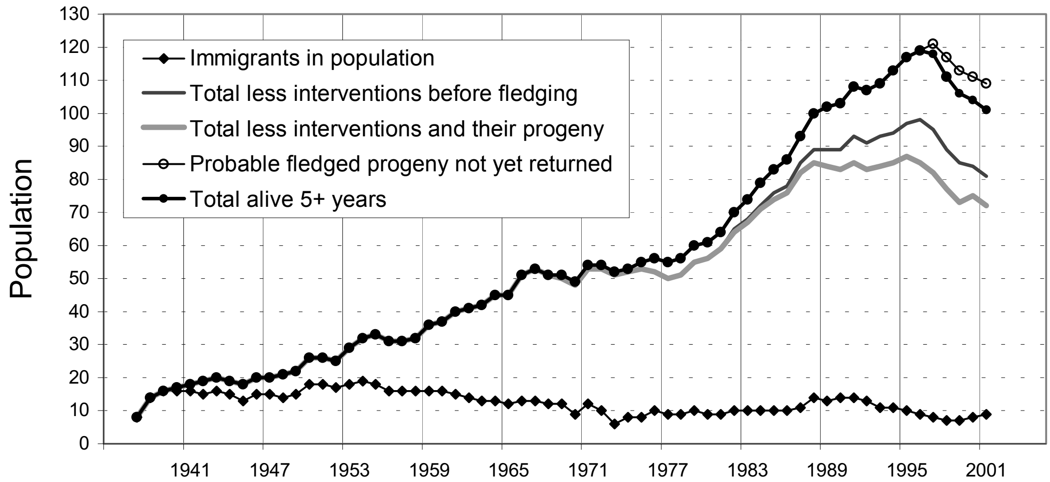

Figure 1. Northern royal albatross population statistics, Taiaroa Head, 1937 to 2001.

Overall, 45 'ghost' chicks were fledged until 1995. In the following 5 years, a further 30 'ghosts' were fledged, but as the full return period of five years has yet to elapse, they have not been included in the survival data.

Figure 2 relates the incidence of annual interventions to the total population of the colony. This demonstrates that there is a long lag period before the benefits of intervention are seen in the live population available to breed in the colony at 6–10 years of age. The benefit is compounded when 'ghost' birds themselves breed and their progeny enter the population. The most significant effects should be seen over the next 10 years, when the 'ghost' progeny of the past 5 years (see above) enter the population and commence breeding. In the past 12 years (heavily affected by both climatic and blowfly influences) only 33% of chicks would have fledged without significant intervention, and a high proportion of those had various levels of palliative or preventative intervention (see above) to reduce the level of risk. During this period the active intervention maintained was successful in raising the fledging rate to 72%. Without this direct management intervention there would have been some years when no chicks would have been fledged from the colony, and an increased number of years when no nest sites would have been available for viewing from the public observatory.

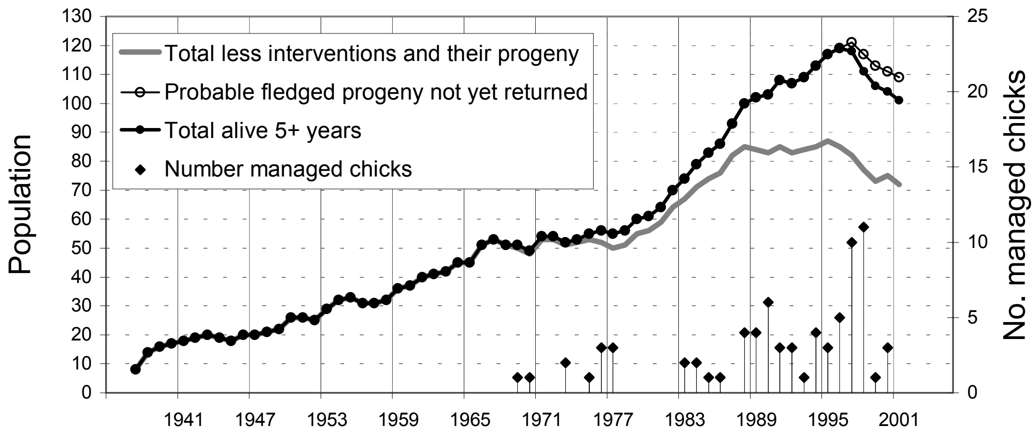

Figure 2. Northern royal albatross population at Taiaroa Head, showing time and quantity of managed progeny against the colony population, 1937 to 2001.

4. Discussion

The population of northern royal albatross at Taiaroa Head provides an important window into the population dynamics of a long-lived seabird. The careful monitoring of known, identifiable birds enables an understanding of the biological processes and individual behaviour patterns which can be exploited to ensure qualitative management intervention. Without the individual and family histories and behaviour precedents available, such active intervention becomes impossible. As an endangered species, the techniques learnt during the past 30 years have application not only to this taxon, but to other endangered seabird populations. As a unique international facility for public viewing, the results of successful management intervention, or its removal, have an immediate effect on public appreciation and education.

As a mainland colony, Taiaroa Head is exposed to significant human-induced effects and introductions which do not occur in the principal colonies at the Chatham Islands. Unfortunately these human-induced effects compound any further impact caused by short- and long-term environmental perturbations. At Taiaroa Head we are fortunate to be able to match simple monitoring data within the colony against a growing knowledge of environmental change and effects. Even within such a long-term dataset, there are data equivalent to only three albatross generations (20–30 years each), and the long-term effects of the past 30 years of intervention and environmental effects will only become apparent during the next 30 years if similar monitoring is maintained.

It is also evident that the colony is not yet of a physical size to survive naturally within a range of short-term catastrophic events, even without the need for protection from human interference and predators. If decisions are considered which reduce or remove active protection and intervention, they will need to be made in the light of the likely immediate and continuing effects demonstrated by the data presented here.

5. Acknowledgements

Since Lancelot Richdale first raised the image of Taiaroa Head as a home for albatross, many people and organisations have contributed to what exists today. However, those front-line professional staff with responsibility for the day-to-day monitoring and interventions have frequently performed miracles, struggled for long hours in trying conditions, and have had the satisfaction of seeing the results. The 75 'ghosts' produced in the past 32 years are a living memorial to their efforts. I acknowledge the careful monitoring and data collection of L. Richdale, S. Sharpe, A. Wright, S. Webb, S. McGrouther and all their various assistants which has enabled me to draw a picture of their results, for without their efforts and the support of many others, the City of Dunedin and the general public would be the poorer. Bruce McKinlay and Ian West reviewed and commented on a draft of this paper.

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