THE SEABIRD RECOVERY PROJECT: LUNDY ISLAND

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Appleton, D., Booker, H., Bullock, D.J., Cordrey, L. & Sampson, B. 2006. The Seabird recovery project: Lundy Island. Atlantic Seabirds 8(1/2): 51-60. *The UK holds 93% of the world's breeding populations of Manx Shearwater* Puffinus puffinus. *Lundy Island's populations of Manx Shearwater and Puffin* Fratercula arctica, *another burrow-nesting seabird, are currently much lower than those reported over 100 years ago. A major factor responsible for these declines was believed to be predation by rats. In 2002 a programme to eradicate rats to benefit these seabirds was started. Both the Black and Brown Rats* Rattus rattus *and* R. norvegicus *occurred on the island. The former is rare in the UK but both are globally widespread and abundant, and both are predators of seabirds. The two-year eradication programme was completed in March 2004, since which there has been no evidence of rats. Monitoring will now focus on the populations and productivity of the target seabirds although an increase in the breeding populations is not expected in the short term.*

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INTRODUCTION

Lundy Island (51°10'N, 04°40'W; 430 ha) lies 18 km off the north Devon coast in the Bristol Channel. Rising steeply to a plateau dominated by grassland and heath, it is a popular tourist destination with 23 holiday cottages, a working sheep farm and a small residential population. Traditionally, Lundy was known as a seabird island holding important populations of cliff and burrow-nesting species. These include the Manx Shearwater *Puffinus puffinus*, for which the UK holds 93% of the global breeding population (Stroud *et al.* 2001), and the Puffin *Fratercula arctica* from which Lundy gets its name ("lund" is Norse for Puffin).

In 2001 the first comprehensive survey of the Manx Shearwater on Lundy using tape-playback at burrows returned an estimate of 166 pairs (Price & Booker 2001). This is much lower than previous estimates from 1976 and 1985 of between 2,800 to 7,000 (Thomas 1981) and 1,200 pairs (Taylor 1985)

respectively. However, these estimates were based largely on counts of birds in flight and may not be directly comparable with the more recent estimate.

For the Puffin a similar decline is evident: in 2000, only 13 individuals were counted compared with an estimated 3,500 pairs in 1939 (Perry 1940). Several factors could have caused the declines in these seabird species on Lundy of which predation by rats (Rattus *spp.*) on eggs and chicks was believed to be one of the most important. Lundy's Manx Shearwater and Puffin populations are significantly lower than those on nearby Welsh islands of Skomer and Skokholm both of which are rat free. Rats can devastate seabird populations on islands but recovery following rat removal is documented (Micol & Jouventin 2002; Stoneman & Zonfrillo 2005). In 2001 a feasibility study concluded that, with systematic and comprehensive use of poison bait, eradication of rats from Lundy was a realistic and achievable goal (Bell 2001). On this basis an eradication programme was initiated in 2002.

Unusually, two species of rat have been recorded on Lundy: the Brown Rat *Rattus norvegicus* which is ubiquitous in mainland Britain and the Black Rat *R. rattus* which is nationally rare. Historically the Black Rat was widespread in the UK and Ireland but is now largely confined to four island groups. It was probably replaced by the Brown Rat when it arrived in the mid-18th century. Both species are globally widespread and abundant (Corbet & Harris 1991) and known to kill and eat adult seabirds, or their eggs or young (Atkinson 1978; Micol & Jouventin 2002).

A description and appraisal of the eradication programme forms the basis of this report, together with some observations on the productivity of the target seabird species, the Manx Shearwater.

METHODS

The primary aim of the Seabird Recovery Project was to remove or reduce the factors preventing the populations of the Manx Shearwater (and Puffin) on Lundy from achieving their potential population sizes. The initial objective was to eradicate the island's rats to allow an immediate increase in the productivity of these two species. The decision to remove the rats was not taken lightly. The eradication programme was likely to be difficult given the terrain. It attracted many protests from people or groups objecting to the use of rodenticides to kill the rats, and the killing of the Black Rat which many considered to be "Britain's rarest mammal" (Appleton *et al.* 2002).

The eradication programme ran from November 2002 to March 2004 with effort concentrated in the two winter periods when the natural food supply for rats was low and take up of bait would be highest. Expert contractors,

assisted by a total of 57 volunteers, conducted the fieldwork, totalling some 2,485 people days.

Rats were poisoned using cereal-based wax bait blocks, each weighing c. 24 g. Three to four of these were set in 2,100 bait stations in a 50 m grid that covered the entire island and offshore stacks; stations consisted of 0.75m long sections of plastic corrugated pipe with a diameter of 0.1m. Bait stations were also placed on the island ferry. All stations were regularly checked and maintained, bait take noted and replaced or changed to ensure a constant supply of intact blocks. Data were collated on a daily basis to track project progress.

The bait blocks contained 0.005% active ingredient difenacoum, a second generation anticoagulant that causes internal haemorrhage by inhibiting synthesis of Vitamin K. For a 400g Brown Rat, the LD50 for difenacoum was 18g of the wax bait block bait. On average two to four feeds are required for a lethal dose, after which death occurs within four to seven days. Difenacoum is a routinely used anticoagulant rodenticide throughout the UK (and the active ingredient in poison bait used for many years previously to control rats in buildings on Lundy).

Monitoring stations within the bait grid held "chewsticks" (wooden pegs soaked in oil) and candles or soap. Rats routinely gnaw on chewsticks etc revealing their characteristic incisor marks providing a further means of detecting their presence when no bait was being taken.

Quarantine measures to reduce risk of rat re-infestation and contingency procedures to remove rats if any were sighted were agreed and drawn up.

Full details of the poisoning programme are given in the unpublished final report (Bell 2004) which can be made available on request.

The likely trends of Manx shearwaters following rat eradication were investigated using difference equations (Croxall & Rothery 1991). The starting population size was taken as 166 pairs and the start date for modelling 2001 when this count was made. The productivity was assumed to be 0.1 chicks per pair prior to rat eradication in winter 2002 (based on data from rat predation years on Canna; A. Ramsay, *pers comm.*) and 0.7 chicks per pair afterwards (based on productivity at rat free islands; Mavor *et al.* 2005). Age of first breeding was assumed six years (Brooke 1990), survival from fledging to the first-year of life to be 44% (Brooke 1990, Perrins *pers. comm.*) and adult survival 93% (Richdale 1963, Bradley *et al.* 1989, Cuthbert & Davis 2002, Perrins *pers. comm.*).

RESULTS

Over the winter of 2002/3 bait uptake, as indexed by the number of stations where bait was replaced, increased rapidly and then declined indicating by

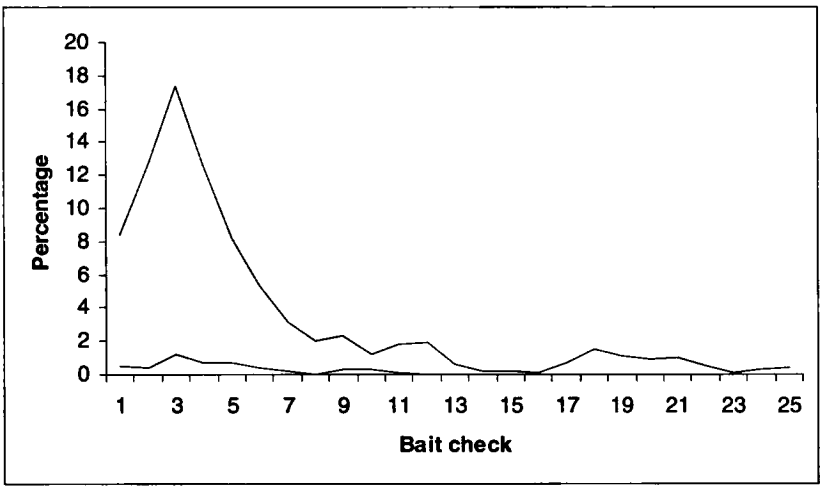

Figure 1. Temporal variation in uptake from bait stations during the poisoning programmes. Top line – from Bait check 1; first part of 2003 (4th January to 4th June), and bottom line – from Bait check; late 2003 to 2004 (9th December to 1st March). From: Bell, 2004.

Figuur 1. Variatie in 'verdwijnen' van aas op aasplekken gedurende het verdelgingsprogramma. Bovenste lijn: eerste helft van 2003 (4 januari tot 4 juni); onderste lijn: eind 2003 tot 2004 (9 december tot 1 maart). Naar: Bell, 2004.

March 2003 a significant decrease in the rat population (Fig 1). However, monitoring of chew sticks revealed that 'hot spots' of rat activity remained. With one exception, these were associated with human habitation and the farm. To target the remaining rats effort was intensified in these areas by using a smaller grid size (25 x 25 m) effectively tripling the density of stations.

By the end of May 2003 monitoring showed that rats where still being detected in the "hot spots". A combination of increased natural food sources, reducing the chance of rats eating bait, and increased visitor pressure meant that the baiting of stations was scaled down until the autumn. In November 2003 both the bait and monitoring grids were re-established over the entire island. Bait take occurred at a small number of locations during December 2003 and January 2004 (Fig 1). However no rat sign was detected on chew sticks at monitoring stations indicating that once bait take had stopped, the rats had been killed.

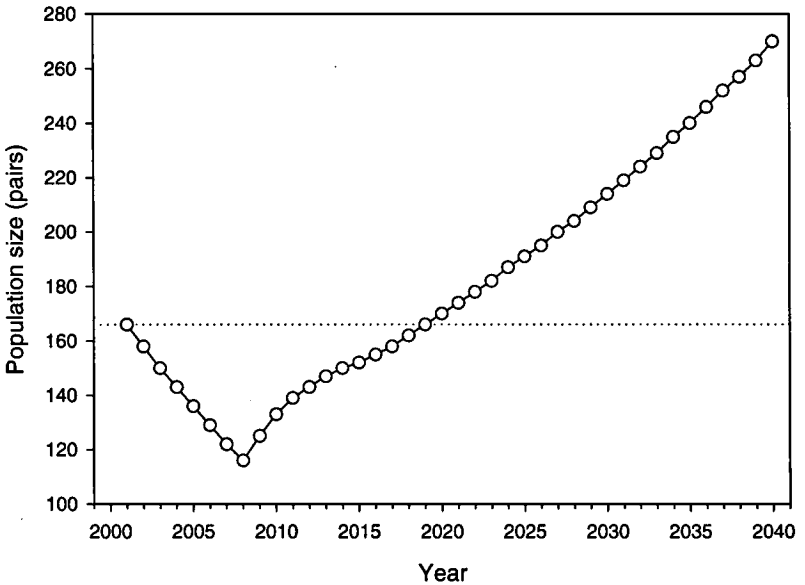

Figure 2. Predicted trend of the Lundy Manx Shearwater population to the eradication of rats in winter of 2002.

Figuur 2. Berekende populatietrend van de Noordse Pijlstormvogel op Lundy na het uitroeien van ratten in de winter van 2002.

The final bait take was noted during February 2004. For the rest of that year, weekly checks of bait stations (initially containing bait, and later candle/soap) located at previous "hot spots" were conducted followed by monthly checks in 2005. No evidence of rats has been recorded since February 2004. In the wild very few rats live for more than a year (Corbet & Harris 1991). A whole island final check in early 2006 confirmed the rat-free status of the island. Monitoring to detect rats will continue indefinitely at the island's jetty and associated buildings.

Quarantine measures have been implemented to prevent rodents reaching Lundy. Contingency procedures have also been drawn up should a rodent be detected on the island (Bell 2004). These have already been used to detect and remove a mouse or mice in the farm buildings where a 25 x 25 m bait station grid within a 50 m radius check of the sighting (of droppings) was installed.

Using the model and assuming a closed population the number of Manx Shearwaters is expected to continue to fall owing to poor productivity during years prior to rat removal (Fig 2). Six years on from rat eradication, the population should increase owing to higher productivity and hence recruitment. The trajectory of the increase is convex between 6 and 12 years following the eradication owing to the declining number of breeding pairs in previous years making the cohorts progressively smaller. Following this period, growth becomes exponential; a pattern that should continue until density dependent limitation causes growth rates to slow. Figure 2 also illustrates that counts prior to 2022 are unlikely to detect an increase in Manx Shearwater numbers, and those made earlier may indeed result in a decline being detected.

DISCUSSION

Eradication of rats from Lundy Island presented many challenges, from the logistical and technical difficulties of working on an inhabited and farmed island which is a tourist attraction, to opposition from animal rights campaigners wishing to conserve the Black Rat and prevent the use of poisons to kill rats (Meech 2005). The feasibility study (Bell 2001) did not take into account an unforeseen increase in visitor use of the island during the winter months. This resulted in additional food sources from the visitors, being available to rats reducing their bait uptake in the crucial winter period. Waste management procedures were significantly tightened during the course of the project to the point where scrap food and animal feedstuffs are now much less accessible to rodents.

In wet weather the bait blocks swelled and crumbled, leaving them unpalatable to rats and requiring frequent replacement. Bait stations, although designed to minimise access by non-target animals and birds, were sometimes damaged by livestock and ponies. Adaptations to stations and project design were generally successful in minimising interference by non-target animals although a small number of crows *Corvus corone corone* (8) and rabbits *Oryctolagus cuniculus* (7), were found to have been poisoned during the two year programme. The crow and rabbit carcasses for which we suspected non-target poisoning as the cause of death were sent to the Department of the Environment Food and Rural Affairs for autopsy and reporting. The post-mortem of one crow revealed traces of three second generation anticoagulants, difenacoum, flocoumafen and brodifacoum, the last two of which are banned for use outdoors in the UK. These incidents strongly suggested that the bait blocks, which should have contained only difenacoum as the active ingredient, also contained traces of more toxic anticoagulants, through contamination during manufacture. The bait manufacturers were immediately informed and

contaminated bait removed and sent back to source. These unfortunate incidents highlighted the problem of the potential contamination of commonly available 'off the shelf' baits.

During the eradication programme on Lundy an attempt was made to collate details of similar projects on four other British Islands (Willcox 2000, 2001; Zonfrillo 2002a, 2002b., B. Zonfrillo *pers. comm.*; Ratcliffe & Sandison 2001, 2002; J. Ratcliffe *pers. comm.*; Bell *et al.* 2000). This was done for two reasons: first to identify common issues and second to compare costs. The islands, including Lundy, varied in size between 32ha and 424ha. Rat eradication cost/ha was however, much less variable: mean = £164/ha, S.E. = 47.67, range = £14-£191/ha. Thus the estimated cost/ha of rat eradication for these British Islands is comparable with area payments for farmland in agri-environment schemes. The success of two of these projects, (Handa and Ailsa Craig), based on an increase in seabird productivity, gave rise to an expectation of a similar result to occur on Lundy.

The eradication of rats from Lundy has been successful. Quarantine measures and a contingency plan are in place to prevent and remove any new invasion respectively. Monitoring will now focus on the breeding success of the burrow-nesting seabirds, and especially the Manx Shearwater. Survey techniques including burrow-scope observations and mark recapture of chicks have been trialled to investigate the productivity of shearwaters on the island. The steep slopes and deep, convoluted burrows make burrow-scopes and other underground studies impractical. Mark recapture will be favoured following observations of juveniles outside burrows at night which confirmed successful breeding in 2004 and 2005 (H Booker *pers. comm.*).

The Seabird Recovery Project cannot be considered a success until we record an increase in the number of breeding pairs of Manx Shearwater on Lundy. The model shows that the population will continue to decline for a further six years following rat eradication and that it is only likely to exceed the 2001 count after 2022. This assumes, however, that the population is closed. Brooke (1990) suggested that half the chicks fledging from Skokholm move to other colonies. Given that Lundy is only 60 km away, it is highly likely that it will receive immigrants from this and other Pembrokeshire colonies. Even if the proportion of Pembrokeshire fledglings emigrating to Lundy was small, this could generate a higher rate of increase than predicted by the closed population model owing to the relative sizes of the source and recipient colonies.

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HET ZEEVOGELHERSTELPROJECT OP HET EILAND LUNDY

Groot-Brittannië herbergt 93% van 's werelds broedpopulatie van Noordse Pijlstormvogel *Puffinus puffinus.* De populatie van Noordse Pijlstormvogel en Papegaaiduiker *Fratercula arctica,* een andere in holen broedende zeevogel, is momenteel veel lager dan honderd jaar geleden werd gemeld. Predatie door ratten werd geacht een belangrijke factor voor deze afname te zijn. In 2002 werd een programma gestart om ratten uit te roeien, met als doel om de populaties van deze zeevogels te herstellen. Zowel de Zwarte, als de Bruine Rat *Rattus rattus* en *R. norvegivus* kwamen op het eiland voor. Eerstgenoemde soort is zeldzaam in Groot-Brittannië, maar beide komen wereldwijd voor, zijn algemeen én prederen zeevogels. De twee jaar durende uitroeiingscampagne werd maart 2004 afgesloten en sindsdien is geen bewijs voor hun aanwezigheid. Hoewel een toename in de broedpopulatie niet op de korte termijn verwacht wordt zal monitoring nu geconcentreerd worden op de populaties en productiviteit van de doelsoorten Noordse Pijlstormvogel en Papegaaiduiker.

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