THE NATIONAL TRUST FOR SCOTLAND'S SEABIRD RECOVERY PROGRAMME: PROPOSED BROWN RAT ERADICATION FROM THE INNER HEBRIDEAN ISLANDS OF CANNA AND SANDAY

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Patterson, A.J., 2006. The National Trust for Scotland's seabird recovery programme: proposed Brown Rat eradication from the Inner Hebridean Islands of Canna and Sanday. Atlantic Seabirds 8(1/2): 61-72. *The islands of Canna and Sanday are situated off the west coast of Scotland within the Inner Hebridean archipelago. The island of Canna is the largest being 5 mile long by 2 mile wide and Sanday 1½ mile long by ½ mile wide. The islands (excluding all inbye land) were designated an SSSI in 1987 and an SPA in 1997 for their seabird and raptor populations, particularly Manx Shearwater* Puffinus puffinus, *Shag* Phalacrocorax aristotelis *and White-tailed Eagle* Haliaetuus albicilla. *Studies carried out by The Highland Ringing Group have highlighted declines in several species of seabirds. The National Trust for Scotland in conjunction with the Highland Ringing Group investigated the cause of decline and brown rat was suspected to be the main cause. Some remedial work was carried out in 1997-1999 to prevent Manx Shearwater declining further but this species became extinct in 2000. Plans for a full rat eradication program were initiated in 1997 for the islands of Canna and Sanday and research into the environmental impact on other species for such a program were undertaken. A small mammal survey took place 1997-1999 since little was known on this group's status. Studies found that there were few species on the islands and that numbers were low. It was found that Wood Mouse* Apodemus sylvaticus *had an interesting physiology and that further work would be needed to establish if this was genetically different from mainland species. However, this added to the project where this species had to be protected and samples are now in quarantine in Edinburgh Zoo until the eradication program has been completed. A rat distribution survey was carried out in the winter of 2000-2001 to determine their location and rough densities. There are several raptor species on the island and most do scavenge rabbits and rats which will be affected by poisoning. Though secondary poisoning in raptors using a 1st generation poison is unlikely, these risks had to be reduced to an acceptable level. A steering group was set up in 2003 to carry the project forward. LIFE-Nature fund application was made to Brussels and the Trust has now received full funding for the project.*

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INTRODUCTION

The islands of Canna and Sanday are situated off the west coast of Scotland within the Inner Hebridean archipelago. A small farm, light crofting and tourism constitute the main livelihood of the 12 residents currently living on the

islands, which are owned by The National Trust for Scotland (NTS). The islands (excluding all inbye land) were designated a Site of Special Scientific Interest (SSSI) in1987, for their biological and geological features, and a Special Protection Area (SPA) in 1997 for raptors and seabird populations, particularly Manx Shearwater *Puffinus puffinus* and European Shag *Phalacrocorax artistotelis.*

Over the past 30 years, The Highland Ringing Group has, on behalf of The Joint Nature Conservation Council (JNCC), collected data on seabird breeding success and numbers through the Seabird Monitoring Programme Canna Studies. These studies have highlighted a decline in seabird numbers between 1973 and 2004 with a steep decline from the nineties. Burrow-nesting birds such as Manx Shearwater showed a very dramatic decline. More recent declines have been noted in more robust species such as European Shag and Razorbill *Alca torda.* Predation by Brown Rats *Rattus norvegicus* has been identified as the cause of the decline, and a series of studies were initiated by The National Trust for Scotland to investigate the feasibility of setting up an eradication programme, with a future Brown Rat control programme, and to establish the impacts this may have on non-target species. This programme of eradicating Brown Rats began in September 2005.

SEABIRD DECLINE

Overall there has been a 49% decline in seabirds between 1995 and 2004, with Manx Shearwater showing the steepest decline, at 99% (Table 1). All species have exhibited marked declines, with the exception of Black-legged Kittiwake *Rissa tridactyla,* which has experienced a 44% increase in numbers (Table 1). Other seabird colonies within the archipelago have faired better and do not share Canna and Sanday's trends, suggesting that the problem of seabird decline is local.

The population of Manx Shearwaters was estimated as between 1000-1500 pairs in 1973, since when it has been monitored annually. This species has been decreasing since 1976, with a sharp decline in 1989 when only 15 out of 62 study burrows contained chicks, and only four chicks successfully reared (Swann, 2001). By 1998 productivity in the colony was too low to measure (Figure 1).

Table 1. Percentage change in numbers of breeding seabirds (individuals) for each species on Canna and Sanday 1995-2004.
Tabel 1. Procentuele verandering in aantallen broedende zeevogels (individuen) op Canna en Sanday 1995-2004.

Species	1995	2004	Increase (%)	Decrease (%)
Manx Shearwater	268	2		99
Northern Fulmar	1306	886		32
European Shag	2060	1080		48
Common Guillemot	7716	6243		19
Razorbill	2104	498		76
Atlantic Puffin	1225	740		40
Black Guillemot	85	44		48
Common Gull	34	12		65
Lesser Black-Backed Gull	78	26		67
Herring Gull	2652	744		72
Greater Black-Backed Gull	170	88		48
Black-legged Kittiwake	1864	2680	44	
Common Tern	6	2		67
			Overall decline	49%

In May 2000 no responses were elicited when a tape was played to 240 burrows within the study area, though in 2001 a single bird responded (Swann *pers. comm.*). Historic nesting sites were checked in June and again in August 2001. Shearwaters were heard calling in flight at some of these locations at night and additional checks were made by day using tape playback. Although there was some physical evidence of burrow occupancy in terms of droppings at burrow entrances, no birds responded (Patterson 2003). The nearby Manx Shearwater colony on the island of Rum has not shown a decline, though data is inconclusive and cannot be used as a comparison. (Swann *pers. comm.*).

Northern Fulmar *Fulmaris glacialis* numbers have fluctuated since 1973, with a notable decline in apparently occupied sites (AOS) occurring between 1995 and 1999 (Figure 2).

It is difficult to draw any clear trends from this as different counting methods were used and the number of non-breeders occupying sites in mid-summer may vary (Swann *pers. comm.*). In one study site in 1997, out of 16 Northern Fulmar eggs laid only four chicks fledged, and in 1998 out of 12 eggs laid only one chick fledged. In 2004 breeding success was 0.56 for all study plots collectively. Sites on high inaccessible cliffs tended to be more successful, possibly because rats could not gain access.

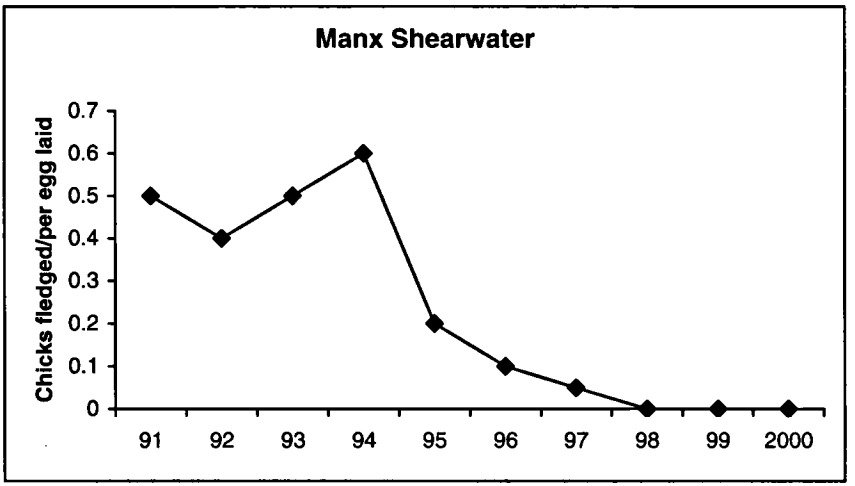

Figure 1. Manx Shearwater chicks fledged per egg laid within study plots where the species became extinct in 2000.

Figuur 1. Aantal uitgevlogen jongen per gelegd ei in studieplots, waar de Noordse Pijlstormvogel in 2000 was uitgestorven.

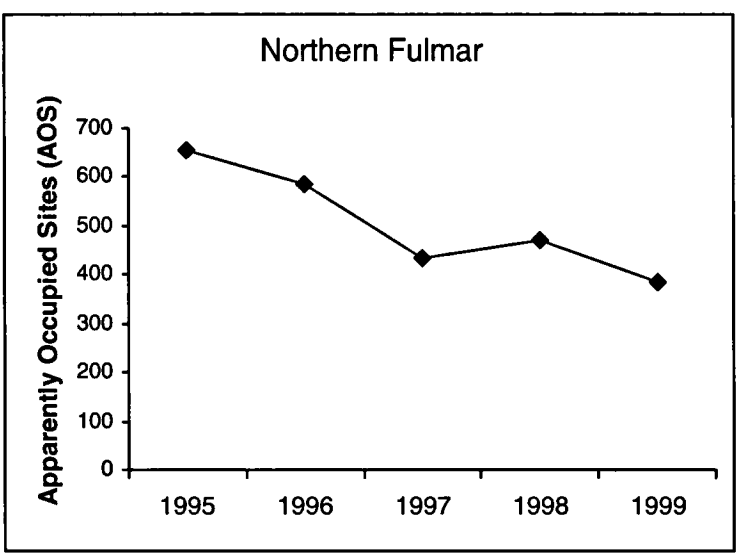

Figure 2. Declining trend off Northern Fulmar decline in Apparently Occupied Sites.

Figuur 2. Een afnemende trend in het aantal door Noordse Stormvogels bezette nestplaatsen (AOS).

The European Shag colony is located in a boulder field at the foot of cliffs at Garrisdale, in the west end of the island. There was a steady increase in the European Shag population throughout the 1970s to the 1980s; thereafter there has been a steady decline. The number of apparently occupied sites (AOS's) remained fairly constant during the 1990s followed by a decline from 2002. Up until 2000 there were increasing numbers of nest failures at the colonies at Garrisdale and Nunnery. There was an almost complete failure at the Nunnery and Lamasgor colonies in 2000 and 2001 (Swann 2001). Surviving nests were restricted to inaccessible cliff ledges or deep recesses under large boulders at the top of the colony furthest from the shore. At Garrisdale all nests failed except for a small section in the core of the colony where breeding success was normal. In contrast the large colony at Geugasgor had normal breeding success. Of the four, this colony is the most inaccessible to ground predators being on a raised wave-cut platform below high cliffs. In 2004 all nests failed at Garrisdale and the remains of predated eggs were found and strongly suggest that rats may be to blame. Overall at Garrisdale three nests produced chicks with a success rate of 0.1 chicks per nest and these were all on inaccessible cliffs (Swann 2004).

Between 1979 and 1996, 400 to 500 Razorbill AOS were counted at Geugasgor. Other sites have fluctuated above and below 100 AOS with a steady decline from 1995 to 2004 (Swann in press). The number of chicks produced declined over the period 1986-2000 from 550 to around 420. However, the study areas of the Nunnery and Garrisdale showed a particularly dramatic decline, and almost total breeding failure occurred in 2000. Geugasgor colony being less accessible was initially less affected but declined from 1995, and there is strong evidence indicating that ground predators may be responsible for this decline (Swann, 2001). There were signs of Brown Rat activity in these areas in the form of rat runs and droppings. In 2004 the total count for Canna was 169 nests with 162 of those at Geugasgor. Many previously occupied Razorbill sites, for example Garrisdale and the Nunnery, are now totally abandoned and large numbers of predated eggs were found in the Geugasgor colony.

BROWN RAT SURVEY

A survey was carried out in winter 2000-2001 to map the distribution of Brown Rats and to record rough densities throughout the islands (Patterson & Quinn, 2001). Winter was chosen because Brown Rats are at their weakest with relatively little food available and this time would coincide when an eradication programme would have the greatest chance of success (Zonfrillo *pers. comm.*). Survey points were made up of four chewsticks coated with lard and placed into

the ground, the site marked with a bamboo cane for ease of locating and survey points placed in a 200 m² grid. Rats can detect food on average 300 m away and a 200 m grid should, given the right circumstances away from other competing food sources, attract Brown Rats (Taylor 1978). To check for movement between islands, survey points were placed on the pedestrian bridge linking Canna and Sanday, and also on small islets accessible at low tide. This survey pattern was detailed enough to monitor all Brown Rat activity on the islands (Figure 3). The presence of Brown Rats was determined by teeth marks on gnawed chewsticks.

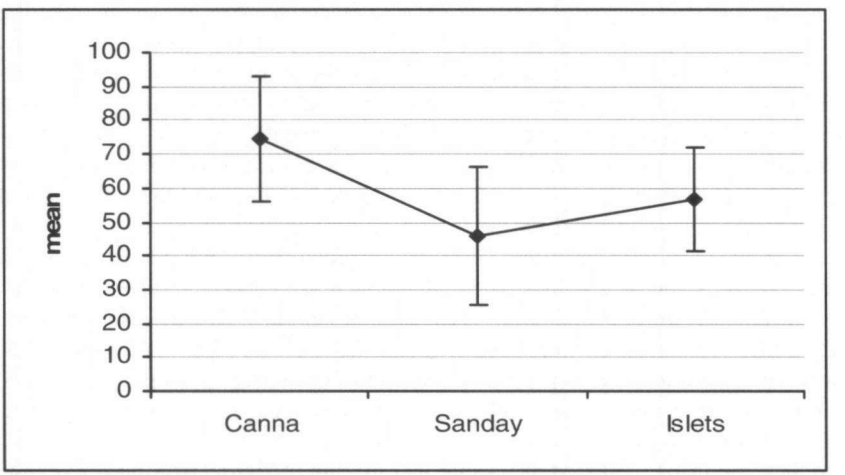

Figure 3. Mean (± SE) of chewstick activity on Canna and Sanday and small accessible islets.

Figuur 3. Gemiddelde 'kauwstok-activiteit' (± SD) op Canna, Sanday en kleine toegankelijke eilandjes.

Of a total of 434 chewstick stations, 343 were on Canna, 78 on Sanday, three on the footbridge that connects the islands, and a further 10 on small islets. Small offshore islands and sea stacks were not surveyed. Chewsticks were coated in lard as an attractant for rats and chew marks then recorded on a scale of 1-5 where 1=light chewing (low activity), and 5=heavy chewing (high activity). The highest level of rat activity was found around the coast reflecting the greater availability of food washed up. Brown Rat activity was also found on inland areas and correlated with watercourses and Rabbit *Oryctolagus cuniculus* colonies. Brown Rats coexist with Rabbits in their burrows and prey on sick or weak individuals as a food source. Myxomatosis was widespread on Canna and Sanday during the survey period and an abundance of carcasses and ailing

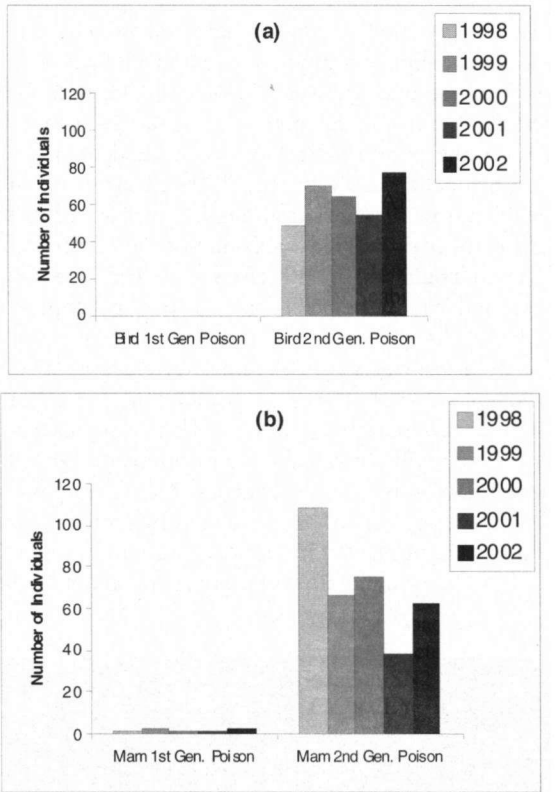

Figure 4. (a) Reported 1st and 2nd generation poisoning incidents in birds. (b) Reported 1st and 2nd generation poisoning incidents in mammals.
Figuur 4. (a) Gemelde eerste en tweede generatie vergiftigingen bij vogels. (b) Gemelde eerste en tweede generatie vergiftigingen bij zoogdieren.

individuals was available to rats. There are several islets adjacent to Canna and Sanday that can easily be accessed at low tide. Of the two islands and four islets included within the survey, only two of the smallest islets had no signs of rat activity. The presence of rats on the other larger islets highlights that Brown Rats will cross at low tide and access both Canna and Sanday. Chewstick stations on the footbridge showed no signs of Brown Rat activity indicating that they will not cross at this point.

NON-TARGET SPECIES

Diphacinone, a first generation anticoagulant rodenticide, will be the primary poison for the eradication programme. Diphacinone has limited, if any, secondary effects on raptors. Between 1998 and 2002 in the UK there were no incidents reported of birds being poisoned by a first generation rodenticide, whereas over the same period there have been incidents of poisoned birds by second generation rodenticides (DEFRA 1998 to 2003). Similarly, there are very few cases of first generation poisoning in non-target mammals, in contrast to a much larger number poisoned by second generation rodenticides (Figure 4 a & b). However, it could be hypothesised that there are more farmers/land-owners using second generation poisons than first generation poison and that this will skew the results.

Raptors are a priority when planning an eradication programme. It is important to maintain and increase productivity of White-tailed Eagles *Haliaeetus albicilla* as, the two pairs on Canna represent 6% of the UK population. All poison will be placed in bait stations designed to prevent access to species larger than rats and so inaccessible to raptors. Rats will die underground and therefore cannot be scavenged by raptors. Poison is contained in wax blocks and held in place with a metal pin within a plastic flexible tube, which is secured to the ground with metal pins and cannot be pulled out (Figure 5).

Figure 5. Poison bait dispenser made from drainage flexible plastic piping.
Figuur 5. Doseerbuis voor vergiftigd aas, gemaakt van een flexibele plastic afvoerbuis.

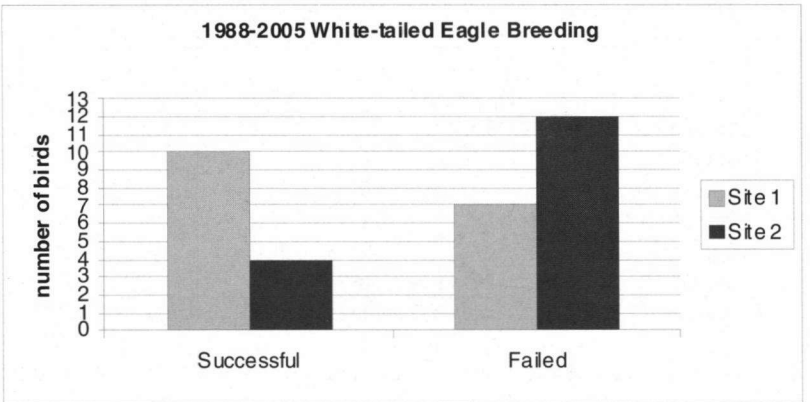

Figure 6. Breeding success of White-tailed Eagle at site 1 and 2.
Figuur 6. Broedsucces van Zeearend op 'site 1 en 2'.

The timing of the eradication (start September / October 2005) will also reduce the risk of disturbance to raptors and should be completed by May 2006. Raptor areas can be poisoned early in the season to prevent disturbance.

It is possible that rats may be causing problems to the breeding success of White-tailed Eagles, though no evidence exists. Of 13 breeding attempts at one site, ten were successful, while at another site chicks only fledged in 4 out of 16 attempts (Figure 6). The low success rate at Site 2 could be caused by many variables but rats have to be considered (Patterson 2003).

SMALL MAMMALS

Other than rats, the small mammal fauna of Canna and Sanday is limited to Wood Mouse *Apodemus sylvaticus* and (in smaller numbers) Pygmy Shrew *Sorex minutus* (Patterson & Brough 1999: Patterson & Lloyd 2000). Wood Mice on Canna and Sanday are apparently morphologically unique, being heavier than their mainland conspecifics (Table 2).

Small mammals are susceptible to Diphacinone poison and populations could be depleted during the eradication programme. The 50m grid is designed so that species with smaller home ranges will not always encounter bait stations, and so it is hoped that many Wood Mice and Pygmy Shrews will not be poisoned. In addition, samples of Wood Mouse will be kept in quarintine at Edinburgh Zoo and at Kincraig Wildlife Park. They will be allowed to breed in captivity and thereafter be released on Canna and Sanday.

Table 2. Weight (g) and home range of Wood Mouse from Canna and other areas.
Tabel 2. Gewicht (g)en homerange van Bosmuizen op Canna en andere gebieden

Location	Males			Females		
	Mean	Range m^2	*n*	Mean	Range m^2	*n*
Perthshire[a]	19.1	13-27	20	17.8	13-24	13
Muck[b]	19.0		3			
Rum[b]	30.6		19	31.7		6
Canna	28		11	23.5		5
Eigg[b]	27.4		4	30.3		5
Canna[c]	33.8	27-41	18	33.3	31-35	6

[a] *Flowerdew 1991;* [b] *Berry, Evans & Sennitt 1967 &* [c] *Patterson & Lloyd 2000.*

Baseline data from surveys carried in 1999-2000 will facilitate comparison with post-rat-eradication numbers. Densities of the two species are expected to increase in the absence of rats (from current low numbers), Brown Rats having been shown to suppress numbers of Wood Mice on Rum (Berry *et al.* 1967). Feral Cat *Felis catus* are common on Canna, however these predators may also play a role in regulating numbers of small mammals.

CONCLUSION

Seabirds have been declining steadily for 30 years with a more pronounced decline in the last 10 years. If left unchecked, further extinctions will occur, as seen recently with Manx Shearwater. There is strong evidence to suggest that rats are the main predator causing these declines. Rat eradication is the only answer to this problem and mitigation procedures have been put in place to safeguard small mammals and raptors. The consequences of the accidental mortality of raptors on Canna resulting from the eradication programme would be extremely serious both for the conservation of the species and the adverse publicity that it would generate. It must therefore be avoided at all costs. Nevertheless, it is concluded that the mitigation measures proposed are such that the residual risk to White-tailed Eagle are vanishingly small and, the risk to small mammals reduced to an acceptable low-level to prevent extinction from rat-eradication activities.

ACKNOWLEDGEMENTS

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for the project and many other people who have given advice and help. To our funding bodies: Scottish Natural Heritage, Royal Zoological Society Edinburgh and LIFE-Nature 2005.

DE ZEEVOGELHERSTELCAMPAGNE VAN THE NATIONAL TRUST FOR SCOTLAND: VOORSTEL TOT UITROEIÏNG VAN BRUINE RAT OP CANNA EN SANDAY

De eilanden Canna en Sanday liggen voor de westkust van Schotland, in de archipel van de Inner Hebrides. Met een lengte van 5 mijl en een breedte van 2 mijl is Canna het grootst; Sanday is 1½ bij ½ mijl groot. De eilanden kregen in 1987de status van Site of Special Scientific Interest (SSSI) en in 1997 de status van Special Protection Area (SPA, Vogelrichtlijngebied) vanwege de populaties van zeevogels en roofvogels, met name van Noordse Pijlstormvogel *Puffinus puffinus*, Kuifaalscholver *Phalacrocorax aristotelis* en Zeearend *Haliaetuus albicilla*. Onderzoek door The Highland Ringing Group toonde een afname van verschillende zeevogels aan. De National Trust for Scotland heeft, samen met The Highland Ringing Group, onderzocht wat de oorzaak van deze afname was; predatie door bruine ratten is waarschijnlijk de hoofdoorzaak. In 1997-1999 werden herstelmaatregelen genomen om verdere afname van Noordse Pijlstormvogel te stoppen, maar deze soort was in 2000 verdwenen.

Plannen voor een campagne om ratten op Canna en Sanday uit te roeien werden in 1997 geïnitieerd, terwijl onderzoek naar de invloed van een dergelijke campagne op andere soorten werd opgezet. Een inventarisatie van kleine zoogdieren vond in 1997-1990 plaats, omdat er weinig bekend was over de status van deze groep. De inventarisaties lieten zien dat er een klein aantal soorten in lage aantallen op de eilanden voorkwam. Er werd vastgesteld dat de Bosmuis *Apodemus sylvaticus* een interessante fysiologie had, en dat verder onderzoek nodig is om vast te stellen of deze genetisch verschilt van de Bosmuizen op het vasteland. Een inventarisatie van de de verspreiding van ratten werd in de winter van 2000/2001 uitgevoerd. Op het eiland komen verschillende soorten roofvogels voor die foerageren op Konijnen en ratten en dientengevolge met gif in aanraking zullen komen. Hoewel secondaire vergiftiging van roofvogels bij een zogenoemd eerste generatie-gif onwaarschijnlijk wordt geacht, moeten de risico's tot een aanvaardbaar niveau beperkt worden. In 2003 werd een stuurgroep in het leven geroepen om de campagne te volbrengen. Na een subsidieaanvraag bij het LIFE-Naturefonds heeft de Trust nu volledige subsidie voor het project ontvangen.

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