LUNDY SEABIRD RECOVERY PROJECT

PROJECT SUMMARY

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David Appleton – English Nature
Helen Booker – RSPB
David Bullock – National Trust
Ben Sampson & Liza Cole – Landmark Trust

ENGLISH NATURE The Landmark Trust THE NATIONAL TRUST RSPB

Disclaimer: This summary has been prepared by the members of the Sea Bird Recovery Project to inform the decision making processes involved in the running of a complex project of this nature. The document is therefore regularly updated to include new information or changes in methods resultant from the project work.

All enquires relating to content of this document should be directed too:

David Appleton: English Nature (Devon), Level 2 Renslade House, Bonhay Road, Exeter, EX6 8LY
devon@english-nature.org.uk

LUNDY SEABIRD RECOVERY PROJECT

1. BACKGROUND

Lundy Island, c500ha in size, lies 10 miles off the north Devon coast. It is surrounded by internationally important marine habitats and is an important seabird island, supporting breeding guillemots, razorbills, kittiwakes, fulmars, gulls, puffins and Manx shearwaters. Much of Lundy is designated a Site of Special Scientific Interest (SSSI) to protect its natural and semi-natural habitats and its native wildlife, including the seabird colonies. The island is also host to a number of alien species, including brown and black rats, which have become established on the island, threatening the native species. The impacts of rats on burrow nesting Manx shearwaters and puffins is of particular concern.

2. PROJECT AIM

To increase the breeding productivity and populations of burrow nesting seabirds on Lundy.

3. OBJECTIVE

To eradicate rats from Lundy, enabling seabird productivity to increase and to allow populations to recover towards former levels.

Population targets:	Manx shearwater	1000 pairs by 2050	2000 by 2100
	Puffins	500 pairs by 2050	3500 by 2100

4. CONTEXT OF PROJECT

4.1 International

The Convention on Biological Diversity, triggered by the Earth Summit held in Rio in 1992 was the start of the Biodiversity Action Plan process in the UK and other participating countries. By 2000, 179 governments had signed up to taking appropriate measures to conserve biodiversity. Article 8(h) of the convention requires signatory countries to, as far as possible and appropriate *"prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species"*.

Alien species, or non-native species, are defined as a species occurring outside of its natural range (past or present) and dispersal potential (...with or without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce (IUCN, 2000)

Invasive alien species are defined by the World Conservation Union (IUCN) as:

"*.. species which become established in natural or semi-natural ecosystems or habitat, are an agent of change, and threaten native biological diversity.*" (Genovesi, 2000)

During the 1990s the IUCN made invasive species a primary focus for its global action, supported by the Invasive Species Specialist Group (IUCN/ISSC, 2000). The IUCN is a major partner of the Global Invasive Species Project (GISP) that, since 1997, has worked to develop a comprehensive strategy for collaborative international action on invasive species.

In Europe, article 11 (2b) of the Bern Convention of European wildlife and Natural Habitats, 1979, requires each contracting party to undertake to strictly control the introduction of non-native species.

4.2 National

In the UK, the Government is required to act according to the Convention on Biological Diversity. The Biodiversity Research Working Group, Science in Action for Biodiversity, has initiated a programme to address the impacts of introduced species.

The UK Biodiversity Action Plan includes a Habitat Action Plan for Maritime Cliffs and Slopes, which includes the action:

"To conduct operations to remove rats, cats or other introduced predators affecting breeding seabirds on maritime cliff and slope sites, identified by Seabird 2000 and other surveys." (Biodiversity Group, 1999)

DEFRA have also set up a group to undertake a review of non-native species policy following increasing awareness of the damage that can be inflicted on native biodiversity by the introduction of non-native species. Triggered by the Countryside and Rights of Way Act 2000, (HMSO 2000) the review involves Government bodies, industry and conservation bodies, considering the causes of, and the problems arising from the introduction of non-native species.

4.3 Regional/Local

The SW Biodiversity Action Plan (South-West Biodiversity Partnership 1997) and the Devon Biodiversity Action Plan (Devon Biodiversity Partnership 1998) also include plans for sea cliff and slope. The latter contains a specific action to

"Ensure offshore islands that hold populations of seabirds are kept free from mammalian predators" (South-West Biodiversity Partnership, 1997)

4.4 Lundy

Rats are amongst a number of non-native species on Lundy and are one of several targets for control. Others include rhododendron, sheep and deer, which are having

a detrimental impact on the island's vegetation, and notably the endemic Lundy Cabbage.

The island's management is co-ordinated by the Lundy Management Group comprising the landowner (National Trust), the tenant (Landmark Trust) and relevant statutory organisations (Devon Sea Fisheries Committee, English Heritage, Environment Agency, English Nature). The Lundy Management Plan 2001 (English Nature, 2001) sets out the island's management objectives for both the marine and terrestrial interests. It includes the objective:

"To maintain or increase the populations of breeding seabird species and provide suitable habitat for migrant birds."

5. TARGET SPECIES FOR RESTORATION

Manx shearwater, puffin

The project is also expected to benefit other seabirds and native wildlife.

5.1 Conservation Status

Manx shearwaters and puffins are amber listed (medium concern) under the UK's Birds of Conservation Concern (Gregory et al, 2002) indicating they have an unfavourable conservation status and are concentrated in Europe.

The colony of breeding seabirds is one of the qualifying features of Lundy SSSI Both species receive statutory protection as part of this interest. Their protection has recently been enhanced by the Countryside and Rights of Way Act 2000 (HMSO,2000), which requires management of SSSIs to ensure their value for wildlife and interest features are maintained.

5.2 Population trends

Manx shearwater

The UK holds 93% of the total breeding population of Manx shearwater (Stroud et al 2001). Outside the UK, Manx shearwater breed in Ireland, Iceland and the Faeroe Islands, with small numbers in France, Madeira, the Azores and Canary Islands. There is little robust population data to allow accurate trends to be measured, although populations are thought to be stable, based on high numbers of birds on rat free islands (RSPB, 1998).

On Lundy, the current population estimate is 166 pairs (Price, Booker 2001). This was the first systematic population survey of Manx shearwaters on the island so a population trend cannot be accurately quantified. Prior to this survey, Manx shearwaters had been studied at night when calling in flight, with population estimates varying from 1000 pairs (Perry 1940) to up to 7000 pairs (Thomas 1981).

Puffin

Puffins are common in and around the north Atlantic but large populations in Norway and the Faeroe Islands declined during the 1970 and 1990. Small populations in France and Russia also declined during the same period. Iceland is thought to hold the largest proportion of the world population.

On Lundy, puffins have been accurately censored since 1939, when their population was estimated at 3,500 pairs (Perry, 1940). There is no population estimate prior to this date. Subsequent counts have revealed a sharp decline in the number of breeding puffins on Lundy, with the population count in 2000 observing only 13 individuals (Price & Booker 2000).

Further details of the population and productivity monitoring of puffins and Manx shearwaters on Lundy is given in Appendix 1.

6. TARGET SPECIES FOR ERADICATION

Brown rat, black rat

Black and brown rats are alien to the UK, having spread across Europe and Britain via early trade routes and shipwrecks. Both species are globally widespread and common (Corbett & Harris 1991)

Black rats arrived in the UK as long ago as the Roman period and have since been largely out-competed by the more versatile brown rat, which arrived much later.

In the UK, black rats are now rare and Lundy is one of their strongholds. However they are also found on other islands, e.g. Shiants Group in the Inner Hebrides and in the Firth of forth (Twigg, 1992). They are also found on Lambay, off Dublin and in ports such as Tilbury Docks. Black rats are thought to have arrived on Lundy in the 17th century (L. Cole pers. comm.) and brown rats in the second half of the 19th century.

6.1 Conservation status

Neither species of rat occurring in the UK is protected by legislation. The black rat is listed on Schedule 9 of the Wildlife and Countryside Act 1981 (HMSO 1981), among non-indigenous species that may not be released into the wild.

There is global evidence of the impact of rats on the native biota of islands and both species fit the IUCN definition of invasive alien species. Both species can attack and kill chicks, and adult birds, and both take eggs. (Atkinson 1985)

Further information on Lundy's rats, their impacts on seabirds, including evidence from Lundy, is detailed in Appendix 2.

Details of other factors affecting seabird colonies and the wider biodiversity benefits of eradicating rats are given in Appendix 3 and 4.

7. PROJECT MANAGEMENT

Following the completion of the feasibility study (see below) the Lundy Management Group decided that on the weight of evidence (see appendices) collected from similar work and the feasibility study the Management Group would support a proposal for the eradication of rats from Lundy. The group established the Sea Bird Recovery Group consisting of English Nature, RSPB, National Trust, and Landmark Trust to take the project forward and provide updates at Management Group meetings

The project is being managed by a close working partnership of English Nature, RSPB, National Trust and the Landmark Trust. Experienced experts will be contracted by RSPB to lead the eradication programme, assisted by a team of trained volunteers. A total of eight people will be required to implement the programme.

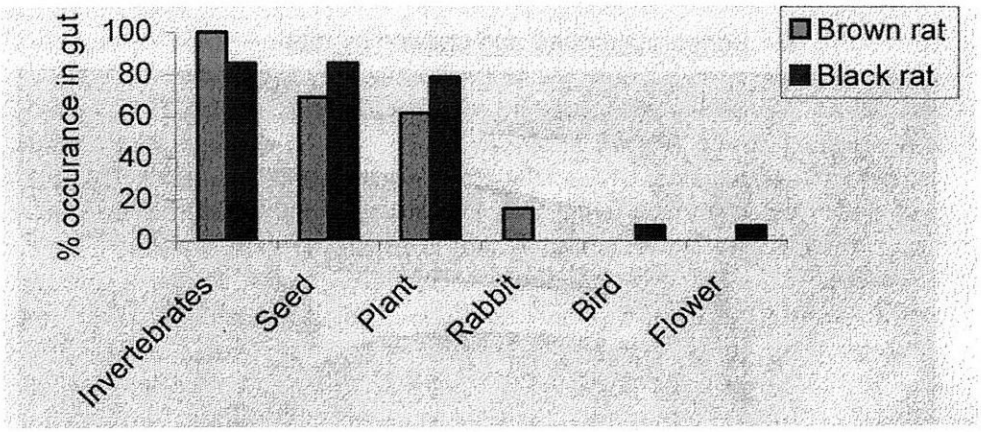
8. THE FEASIBILITY STUDY

A Feasibility study was commissioned by the RSPB with funding from English Nature and The Landmark Trust and was carried by Wildlife Management International Ltd in June 2001 to assess whether it would be possible to eradicate rats from Lundy and if so, the most effective and humane method.

The Feasibility study also included an assessment of the possible impacts on non-target species. The size and distribution of the rat population was assessed using index trapping; each line consisted of 25 traps run over night for three consecutive nights. An index of abundance was calculated, a method used to compare populations in different regions, habitats or seasons (Cunningham and Moors, 1983). The number of rats trapped was described as within the typical range for an offshore island (Moors and Atkinson, 1984). The combination of index trapping and a survey of the island for rat signs revealed an even distribution of rats over the island, with 70% of rat signs, south of Halfway Wall. The majority of rats were caught on the coastal slopes (73%), which also held 61% of rat signs. 48% of rats caught were male, 31% were juvenile. All adult females were pregnant with second or third litters (6 to 9 embryos each). Maps showing the distribution of trapped rats and rat signs are given in Appendix 6.

Stomach content analysis was carried out on captured rats. The results of this analysis are shown in Figure 1 below:

Figure 1:



8.1 Method of eradication

The Feasibility Study (Bell 2001) recommends the use of Difenacoum, the poison used for the successful eradication programme on Ramsey Island. It is not possible to use first generation anti-coagulants such as warfarin because rat control has been carried out on Lundy on a variety of scales since 1987 (Wolton 1995). During this time Wafarin has been the preferred poison. It is known that rats develop a resistance to first generation rodenticides (Buckle 1994). The project has been advised to use the second generation chemicals as the risk to non target species is considered to be minimal.

The poison will be incorporated into cereal blocks and placed in bait stations, set out in a 50m grid over the entire island. The poison is a second generation anti-coagulant requiring rats to take in up to four feeds before the poison becomes lethal. Symptoms do not develop for several days, with the rat dying shortly afterwards (Bell 2001).

The bait stations will be designed to reduce, as far as possible, the risks to livestock, rabbits, crows and gulls. The bait stations will be constructed from 750mm lengths of corrugated plastic drainage pipe, secured to the ground by wire "legs" and/or sand bags, depending on the substrate. The entrance hole to the bait station will be halved by a piece of wire to prevent entry by rabbits or crows. Insects can be deterred by slightly raising either end of the tube. Bait can also be wired into the centre of the bait station and is administered and replaced through hole (with lid) in the top.

Bait stations will be laid in November 2002, with baiting beginning in January 2003. Bait stations will be checked regularly and all carcasses removed (although few are expected) and disposed of in the islands carcass disposal pit.

There could be visitors on the island throughout the programme, so special information sheets will be prepared for visitors during this time.

8.2 Effects on non-target species

The Feasibility Study considered the potential risks to non-target species (Bell 2001). Risks to non-target species will be minimised by using specially designed bait stations. A number of species are considered in the study and at worst the risk of poisoning is "low" (Figure 2). For example, a combination of bait station designs and a system to collect and safely dispose of all carcasses will greatly reduce the chances of poisoning crows, ravens or gulls. Bait station designs will also prevent livestock and feral mammals accessing the bait. Additionally, Difenacoum is antidotal with Vitamin K (injection or tablet form), so any animals accidentally poisoned can be simply and effectively treated (Bell 2001). To further reduce this risk, supplementary food for ravens will be provided on feeding stations, out of reach of rats and a supply of vitamin K will be kept on the island.

Figure 2: Risk Assessment for non-target species

Species	Effect	Preventative Action	Risk
Raven	Direct and/or secondary poisoning by eating poisoned rats.	Bait station designs, all rat carcasses collected.	Low
Crow	Direct and/or secondary poisoning by eating poisoned rats.	Bait station designs, all rat carcasses collected.	Low
Gull	Direct and/or secondary poisoning by eating poisoned rats.	Bait station designs, all rat carcasses collected.	Low
Rabbit	Direct poisoning	Bait station designs	Low
Shrew	Secondary poisoning by eating invertebrates which have consumed bait	Bait station designs	Very Low
Cat	Secondary poisoning by eating poisoned rats	Bait station designs, all carcasses collected.	Low
Horse	Direct poisoning	Bait station designs	Very low
Feral Goat	Direct poisoning	Bait station designs	Low
Soay Sheep	Direct poisoning	Bait station designs	Low
Domestic sheep	Direct poisoning	Bait station designs, good stock management.	Low
Insect	Direct poisoning	Difenacoum does not affect invertebrates. Bait station designs.	Nil

(Bell, 2001)

8.3 Post eradication monitoring

Rats

The eradication programme involves intensive monitoring for rat signs for six to eight weeks following the last take up of poison. This monitoring will be carried out

by the eradication team and involves setting a grid of chew sticks, chocolate, soap, apples etc that will attract any rats that have escaped poisoning. Should rat signs be detected, intensive poisoning will resume in the vicinity.

On completion of the eradication, a monitoring programme will be put in place for four to six weeks during each spring and autumn to confirm the absence of rats. This will be built into the island management and will take place for at least two years after the main eradication programme is complete.

Ongoing monitoring for rat signs around the jetty will also be carried out to ensure any arrivals from boats can be quickly detected.

Birds

- Annual monitoring of study plots and puffin numbers (Warden).
- Full seabird breeding bird survey every six years, including survey of Manx shearwater colonies (RSPB).
- Full Manx shearwater survey every six years (RSPB).
- Land bird monitoring will be undertaken in conjunction with seabird monitoring programmes.

Other vertebrates and invertebrates

- Surveys of pygmy shrews and invertebrates before and after the eradication (NT).

Vegetation

The Feasibility Study shows that seeds and plant material form a significant part of the diet of rats. Eradication could therefore have some impact on the island's vegetation. Monitoring programmes will be established for key vegetation types on the island and management programmes put in place as necessary.

- Monitoring of Lundy cabbage (EN).
- Monitoring of other large-seeded plants (NT).

8.5 Contingency planning

Wildlife Management International (Ltd) are confident that rat eradication on Lundy is feasible and the methods are tried and tested (Bell 2001). However, the outcome cannot be guaranteed and all eventualities must be taken into consideration and planned for.

The project has been designed to eliminate all rats present on the island. However, it cannot be guaranteed that re-colonisation will not occur after the programme is complete. Therefore, a contingency plan containing quarantine measures will be prepared to ensure adequate measures are in place to prevent re-colonisation.

9. PUBLICITY

A media strategy will form part of the seabird restoration programme. The project partners have agreed a proactive approach to the media. A briefing has been prepared for all partners to enable press officers and other staff within the partner organisations to deal with press/public enquiries.

English Nature will be co-ordinating the media strategy and project publicity.

APPENDIX 1 – LUNDY BURROW NESTING SEABIRDS

Manx shearwater and Puffin

Conservation Status

Amber list. The lists were developed using set criteria for bird population and distribution changes. Manx shearwaters qualify for this listing as they fall within the following set criteria:

- Over 20% of the European breeding population is in the UK.
- Over 50% of the UK breeding population can be found in ten or fewer sites.
- The species has unfavourable conservation status in Europe and is therefore of European Conservation Concern.

Puffins qualify for this listing as they fall within the following set criteria:

- Over 50% of the UK breeding population can be found in ten or fewer sites.

The species has unfavourable conservation status in Europe and is therefore of European Conservation Concern.

Regular monitoring of seabird populations on Lundy has been carried out and documented over the past twenty years (Price 1996). Prior to this, the Lundy Field Society Reports contain various observations and seabird counts during the 20th century.

Manx shearwater

Approximately 93% quarters of the global population of Manx shearwater nests on islands within the UK and Ireland (Stroud et al 2001). Of these, two of the most important islands are Skokholm and Skomer off the Pembrokshire coast, 40 miles from Lundy. Both of these are free of rats and support 45,000 and 100,000 pairs respectively (RSPB Conservation officer pers com).

Historical records of Manx shearwaters on Lundy over the past 60 years include a range of population estimates based on birds heard in nocturnal flight around Lundy's coast. The earliest estimate of 1000 pairs in 1939 was made by Perry (1940). Much later, beginning in 1976, David Thomas carried out a five year study of the shearwaters, focussing on night activity. He revealed that birds showed a strong preference for the eastern sidings and west coast either side of Old Light. In 1981 he studied burrows at Halfway wall on the east coast and Battery point on the west coast, estimating 500 pairs at these sites, which extrapolated up to give an ambitious estimate for the whole island of between 2000 and 7000 pairs.

In 2000, an initial survey to identify occupied nests using tape-playback at burrows was carried out and located at least two small colonies on the island (Price and Booker, 2000). This led to the first full burrow survey in 2001, which produced a population estimate of 166 pairs (Price and Booker, 2001). Lundy's small population is made up of a number of small colonies and individual nest sites around the island. The birds occupy only a very small area of the potential habitat, indicating their population could be much larger than at present.

Because Manx shearwaters have so few nesting sites their global population is very vulnerable. The loss of birds from one of the key islands could have devastating consequences. The presence of breeding shearwaters adds to Lundy's importance as a seabird island. (Price and Booker, 2001).

The Isles of Scilly, which hold approximately 200 pairs, are the only other English islands with breeding Manx shearwaters. The Scilly population is located on six islands, with the highest numbers on Annet and Round Island, both of which are free of rats. Very small numbers were found on islands with rats. Rat eradication measures are now in place on the uninhabited islands to restore breeding Manx shearwater populations (A Brown pers. com).

Breeding success

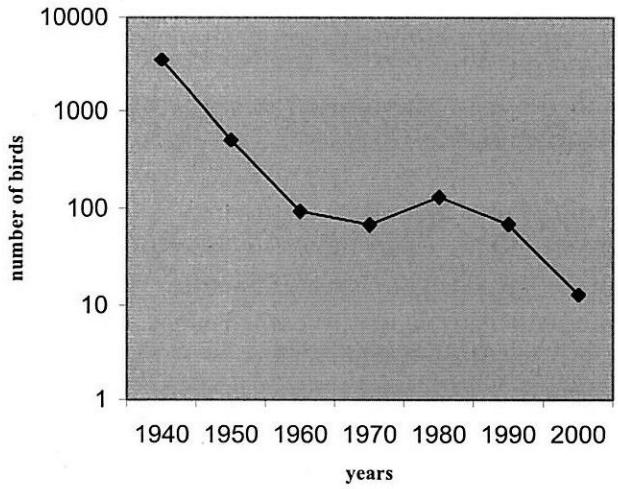
Breeding success of Manx shearwaters on Lundy was last studied in 1985 and 1989. Taylor (1985 & 1989) visited colony areas late in the season, when chicks should still be visited by adults or should be close to leaving. Attempts to catch Shearwaters at both the Old Light and the Tibbet's colony areas in late August / early September in five consecutive years (1979 – 83) all failed, with no birds seen. There was also no evidence of any young birds leaving their nests. In 1987 and 1988 special visits were made to the Old Light colony late in the breeding season. In July 87 just two burrows were found to be occupied by adults, but in late August 1988 there were no signs of any Shearwaters. Holes had grown over, and there was no night time activity, despite torch-light searches and the use of tape lures.

There are only two occasions when successful breeding has been recorded. The first record was in 1959 when a young shearwater with traces of down was found on the island (LFS 1959). The second was in 1966 when the remains of several young birds were found near the nest of a Great Black Backed gull (LFS, 1966). Both these records are chance findings. Most years, the LFS reports typically note that there is *"no evidence of successful breeding"*.

Puffin

The UK puffin population is approximately 900,000 individuals, about 10% of the world population. (RSPB, 1998). The largest colonies occur on Scottish islands, with smaller colonies on islands off the coast of Wales. The earliest written population record for puffins on Lundy was by Richard Perry in 1939, who estimated the population to be around 3,500 pairs (Perry 1940). This figure has since drastically declined until in 2000, only 13 birds were recorded (fig.1). The population prior to 1939 is unknown, but it is likely to have been many thousands of pairs. The population has now reached such low levels that the species may soon be extinct on Lundy unless urgent action is taken.

Fig 1: Trends in the Lundy breeding puffin population 1939 to 2000



Lundy is famous for its puffins and is popular with visitors. The puffin's popularity with visitors is emphasised by the sales of puffin artefacts in the Lundy shop, which provides valuable income to support the island's management. There is also much public and media interest in these attractive birds and support for attempts to try to reverse the species' decline.

APPENDIX 2 – RATS

Black rats

Black rats are smaller, more agile and need more sheltered habitats than the brown rat. Rats tend to attack birds up to their own body weight so that the black rat would not be expected to attack puffins. However, chicks of shearwaters and adult and chick storm petrels could be attacked (Stapp 2001). Brown rats can tackle bigger prey such as puffin chicks. Brown rats almost certainly would attack and compete for food with black rats.

Black rats, native to South-east Asia, may have reached Britain from the Middle East in Roman times. However, by the 18th century, the black rat became out competed by the later arriving, more versatile brown rat. Today, in the UK, brown rats are numerous and black rats are rare. Whilst Lundy is one of the few strongholds for the black rat, the species is global and widespread in southern Europe and present on other islands around the UK and Ireland (Corbett & Harris 1991)

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For example, black rats occur on:

- all three of the **Shiant Islands** in the Inner Hebrides;
- on **Lambay Island**, off Dublin, where brown rats may also be present;
- recent records from the islands in the **Firth of Fourth;**
- they are possibly present on an island in **Wexford Slobs**, off the SE coast of Ireland;
- they have a recent history at **Kew** on the Thames, although their current status there is unknown;
- they may also still at present on the banks of the Thames at **Tilbury docks**
- and on **Sark and Alderney** in Channel Islands (Twigg et al, 2001).

Rats on Lundy

No systematic monitoring of the rat populations on Lundy has been carried out, although there have been a small number of studies, primarily focussing on the black rat. The most recent of these, in 1991, was a study by Reading University (Smith et al 1993) that investigated the status and distribution of brown and black rats on Lundy. The study revealed little about the brown rat, but found black rats occupying only the south-eastern part of the island, with burrows on rocky outcrops and sheltered cliffs. The black rats were found to be active on the cliffs and shoreline at low tide.

The eradication feasibility study in summer 2001 trapped rats and recorded rat signs all around the island (Bell 2001). The study found that both species were widespread across the island, with higher concentrations at the southern end of the island near the village and on the south-eastern slopes in amongst the rhododendron. Both black and brown rats were captured on the east and west sidelands as far north as three-quarter wall. This was clear evidence that black rats are not confined for the SE of the island and occupy the same habitat as the burrow nesting seabirds.

Impacts of rats on native wildlife

There are examples of islands worldwide where rats and other non-native species have been introduced to islands with the arrival of people. Their impact on island ecosystems has been catastrophic, causing massive population declines and local extinctions of native wildlife (Atkinson 1985).

It is well known that burrow nesting seabirds are vulnerable to predation by introduced ground predators. The birds have evolved to nest in burrows that protect them from avian predators, but they have no defences against rats.

In the case of the Manx shearwater, the main breeding colonies in the UK are rat-free islands.

Evidence of predation by rats on Lundy

In terms of threats to breeding success, there would seem little geographical difference between Lundy and the islands off south west Wales, and therefore it would appear likely that the reasons for their failure to breed in large numbers must be more local to the island itself.

There are various historical observations concerning predation of puffins and shearwaters by rats. The paragraphs below summarise these reports.

In 1939, Richard Perry commented that there was a potential rat problem (Perry 1940), although he did not cite specific examples.

Later, in 1948, Studdy found extensive evidence of rat predation at the Old Light colony. The following are some of his comments.

"Attention was drawn to this area [Old Light colony] by the discovery on May 3rd of a rat-eaten corpse of a Shearwater in a burrow".

"Rats were evidently at work here; as evidenced by a quantity of clean feathers found at early morning on several occasions, and a total of ten corpses discovered in burrows"

". . incubation continued until July 8th, on which day the egg was found broken - in Mr Boyd's opinion [the then warden], the work of a rat."

"This slope seems very suitable for Shearwaters and were it not for rats might be successfully colonised."

At Puffin slope he noted that:

". . rats were active to judge from numerous broken Puffin's eggs"

Overall he concludes that:

". . the evidence accumulated suggests that the presence of rats is a serious obstacle, and that while their numbers remain unchecked the Shearwaters will have the greatest difficulty in establishing colonies"

All taken from (Studdy 1948)

The 1952 Lundy Field Society (LFS) (LFS 1952) report contains the comment:

"Many rats were noticed at the colonies visited, and probably few young escaped them"

In 1985, Taylor suggested that his inability to find any birds late in the season was consistent with a high level of predation. He stated:

". . it is likely that, while breeding is continually attempted, it is almost totally unsuccessful because of predation by rats".

The fact that the birds have persisted so long is presumed to be a function of their longevity and continued immigration from the large colonies of Skomer and Skokholm. He concluded that:

"There seems to be no other obvious way of explaining why Lundy does not have a population of comparable size to theirs." (Taylor 1985)

His work in 1987 and 1988 further supports these initial conclusions. In July 1987 at the Old Light colony he found the remains of an adult bird in a burrow, and:

"the chewed bases of the feather shafts suggested predation". In another burrow he found a

"broken egg shell and membrane. The damage to them suggested predation rather than hatching".

These later studies provided further evidence and he again concluded that the birds were

"largely unsuccessful because of predation by rats" (Taylor 1989)

As a postscript to this historical data, during night observations on 8th/9th June 2000, two rats were seen only a matter of 20m from the main Tibbet's colony (H Booker pers com). During the shearwater survey in May 2001, a small wooden peg put in the ground to mark a transect line at the Tibbet's colony, was found with gnaw marks a few days later. Other signs of predation were also noted during the survey, such as broken eggshells, feathers and Manx shearwater carcasses which were found next to burrows. There were also a significant number of holes which had signs of occupation (such as droppings at the entrance) but there were no occupants recorded, possibly indicating the nest had been predated (Price & Booker 2001).

In June 2001, a study was commissioned by RSPB, to assess the feasibility of eradicating rats from Lundy. As part of this study, the population abundance and distribution was determined, including an assessment of the health of the population (Bell 2001).

The rat population size was considered to be "typical" and in good health, with females on their second or third litter of the year at the time of the study. Evidence of rats was located all over the island, with the highest populations in the rhododendron and around the village. Across the rest of the island, the distribution of rats also reflected the distribution of colonies of nesting Manx shearwater and puffin, with rat droppings and broken egg shells found at burrow entrances.

APPENDIX 3 – OTHER FACTORS AFFECTING SEABIRDS ON LUNDY

Possible Impacts Of Other Predators

By nesting underground and entering and leaving burrows at night, Manx shearwaters are adapted to co-exist with avian predators, such as gulls. A study on Skokholm concluded that gulls were responsible for about 10% of total mortality, which was unlikely to have a significant impact on a thriving breeding colony (Brooke 1990).

Ferral cats were eradicated from Lundy in the late 1980s (L Cole pers comm.). The island now has a small number (7) of domestic cats (all sterilised) which predate rats and rabbits, however there are no known cases of seabird predation by these cats on the island (LCole, pers comm.). There are no other mammalian predators on Lundy.

Throughout all the available literature the only threat identified is that of predation by rats, together with just the one reference to a Great Black-Backed Gull in 1966 (LFS 1996).

Other possible factors affecting seabird populations

There are a range of variables such as food supply, pollution, disease or fishing activities that can affect the populations and productivity of breeding seabirds.

Disease

Puffinosis is a viral disease that affects breeding Manx shearwaters on Skomer and Skokholm. However, the disease is considered to be of low importance in conservation terms (RSPB, 1998).

Food

The feeding range of breeding seabirds on Lundy will almost completely overlap with those of birds from Skomer and Skokholm, where breeding populations are high and productivity is successful. There is no evidence of a decline in the sand eel population within the Bristol Channel and it is expected that the population is stable (CEFAS pers comm.) This is a clear indication that factors affecting seabirds on Lundy come from the island itself.

APPENDIX 4 – BIODIVERSITY BENEFITS OF RAT ERADICATION ON LUNDY

Benefits for seabirds of rat eradication

A key nature conservation objective for Lundy is to restore the island's native and indigenous wildlife (English Nature 2001). For seabirds, the objective is to halt and reverse the decline in populations, allowing them to have the chance to recover to former levels. This cannot happen while rats are present.

Puffins and Manx shearwaters are expected to benefit from a rat-free environment, although as the birds are long lived it may be several years before populations show significant increases. From the first year however, productivity should increase enormously, restoring the island to a successful breeding location for these species as has occurred following rat eradication on Handa (Wilcox 2000). On reaching maturity, birds produced on the island are likely to return to breed, gradually increasing the population size. In the long term, there is no doubt that Lundy has the potential to support thousands of pairs of puffins and shearwaters and become one of the most important seabird islands in southern Britain.

Productivity of gulls, kittiwakes, razorbills and guillemots should also increase in the absence of rats. Gulls nest on the open grass sidings and despite their fierce defence of nests, eggs are accessible to rats. Many of the ledges occupied by kittiwakes, razorbills and guillemots are also within reach of rats.

Lundy is also suitable habitat for breeding storm petrel (although its distance from the continental shelf may prevent breeding). There have been occasional diurnal and nocturnal records of birds during the summer and autumn (Dymond, 1980). Storm petrels are difficult to survey on Lundy because any nest sites are likely to be in crevices and amongst loose rocks, low on the cliff. It is possible that currently they attempt to breed on the island and that their productivity is affected by rats. In the absence of rats, non breeders may colonise and the productivity of any established breeders would improve.

Benefits for terrestrial species

It is expected that pygmy shrews, Lundy's only native mammal, would also benefit from a rat free environment, along with ground nesting birds such as lapwing, skylark, meadow pipit and wheatear.

APPENDIX 5 - EXAMPLES OF SEABIRD RESTORATION PROJECTS ON OTHER ISLANDS

Handa Island (Willcox, 2000)

Handa, a privately owned island off the north-west coast of Scotland supports thousands of breeding razorbills, guillemots, kittiwakes and fulmars, yet very few burrow-nesting birds, despite ideal habitat. Rats colonised the island in the mid 1800s, through fishing and sheep farming related activities. Studies of puffins on Handa and a neighbouring rat free island revealed that 94% of birds on the rat free island were recorded nesting in holes on grass slopes above the cliff, whereas on Handa only 4% were recorded above the cliff, a distribution which could be explained by the presence of a ground predator. Evidence of rat predation was also recorded from studies of wax-coated eggs and rat footprints in peat at burrow entrances.

Rat eradication took place over 6 days in March 1997. Following eradication, chew sticks have been used (and continue to be used) to check for the presence of rats each year between April and August. Possible evidence of rats was recorded in 1997 and 1998 and immediately these areas were poisoned. From 1999 onwards, no evidence of rats has been recorded on the island.

Examples of wildlife benefits three years after the eradication (1999):

- Breeding numbers of artic and common terns have increased from 7 to 58 pairs. Productivity has also increased considerably.
- In 1999, for the first time, puffins occupied burrows on steep, short grassy slopes on Handa.
- For the first time, oystercatchers and ringed plovers have bred successfully.
- Up to 11 pygmy shrews have been recorded each year following rat eradication, compared to a total of 8 sightings in the 21 years before.

These initial observations indicate that rat eradication has very quickly brought nature conservation benefits to the island. Future monitoring of all species will take place to assess population trends.

Ailsa Craig (Zonfrillo, 2000)

Ailsa Craig is a privately owned island, which held a small resident human population from the 12th century until the 1950s. In 1871 puffins were described as present in "bewildering numbers....so great they darkened the sky" (Gray, 1871). Rats were first recorded on Ailsa Craig in 1889 at the time of a coal delivery to the island. The wreck of a number large ships on the island during the 19th century are also thought to have introduced more rats to the island. By 1934, the puffin was recorded as "practically extinct". (McWilliam, 1936). Detailed studies of fulmars and gulls on Ailsa Craig during 1989 and 1990 revealed heavy losses at the egg and chick stage. Conversely, fulmars on the nearby rat-free island of Sanda were successfully rearing young, indicating a land-based rather than a sea-based problem. Sanda also has breeding Manx shearwater, storm petrel, black guillemot and puffin – all burrow nesting birds.

Rat eradication was carried out in 1991 using warfarin and the results closely monitored. The effect on non-target species was limited to rabbits, causing a reduction in population as a result of warfarin consumption.

Bernard Zonfrillo reports the following wildlife benefits following eradication:

- Three burrow-nesting bird species have recolonised the island. Black guillemot and shelduck had previously been recorded around the island but had not bred and wheatear had been previously recorded as a migrant only. All three species have continued to breed successfully since the eradication.

- Puffins have also increased in number since the eradication of rats. Numbers have risen from zero in 1991 to 19 in 1993 and 22 in 1999, indicating their numbers will slowly recover.

- Fulmar productivity has recovered from 100% failure to 100% success and gull productivity has also increased.

- Vegetation has also responded favourably following the eradication. Rare and restricted plant species recovered and spread.

- Other native wildlife such as lizards, slow worms and pygmy shrews have been sighted more frequently following eradication.

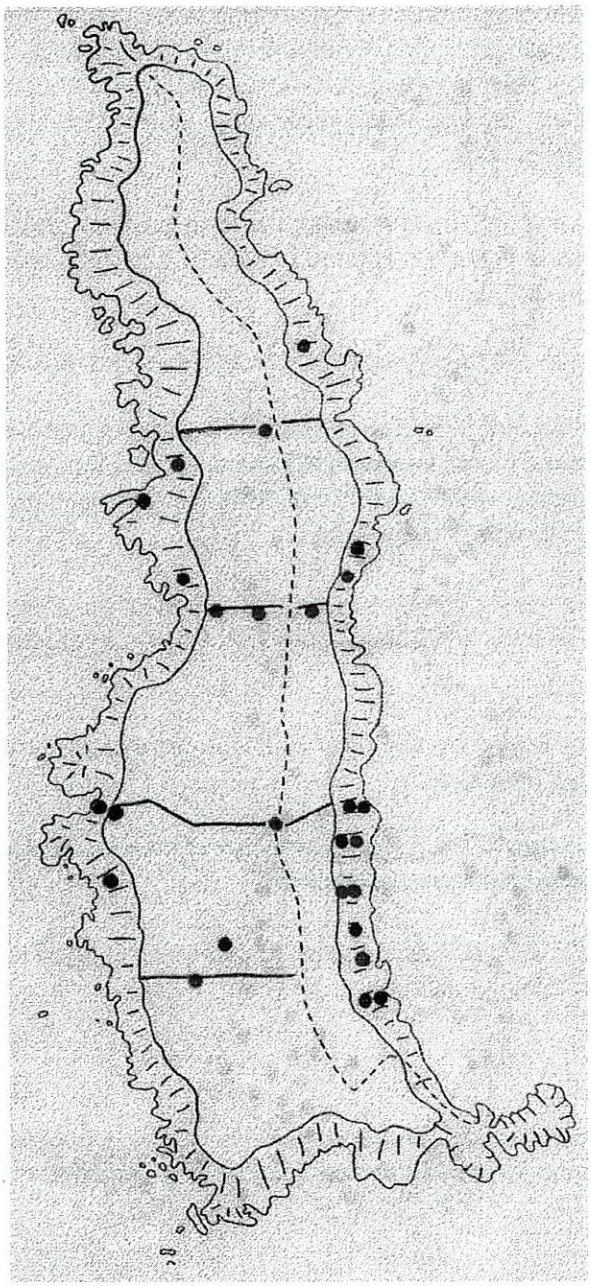
Other islands

In the last couple of years eradications have been successfully carried out on **Ramsey Island** and **Puffin Island** off the Welsh coast. These islands are now being monitored to assess their recovery.

APPENDIX 6 – MAPS SHOWING DISTRIBUTION OF TRAPPED RATS AND RAT SIGNS DURING THE 2001 ERADICATION FEASIBILITY STUDY.

Rat Captures on Lundy

- Black Rat
- Brown Rat



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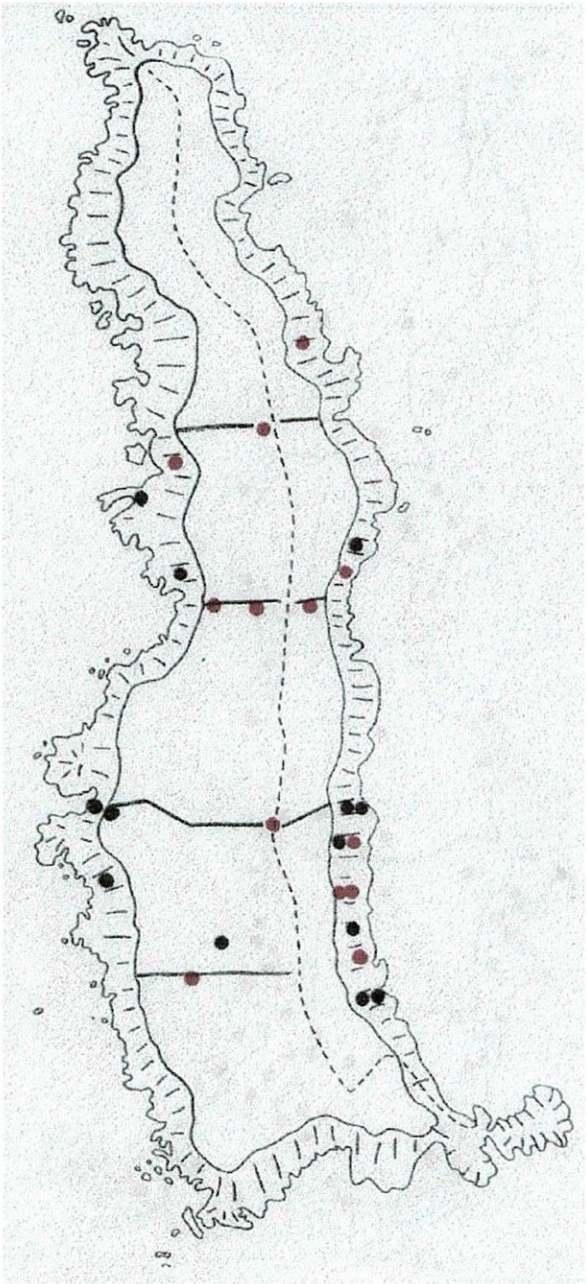
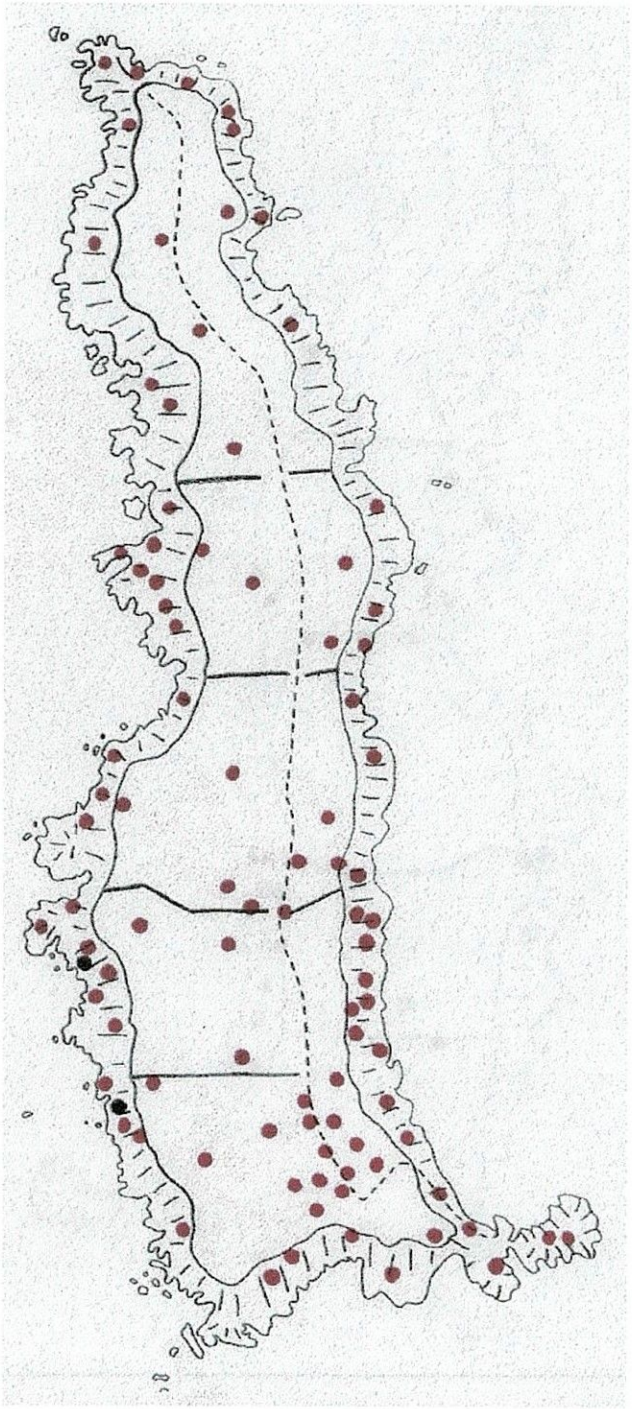


Locations of rat signs on Lundy

- Predation Event
- General Rat Signs (dropping, live sightings, chew mark etc)



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- Predation Event
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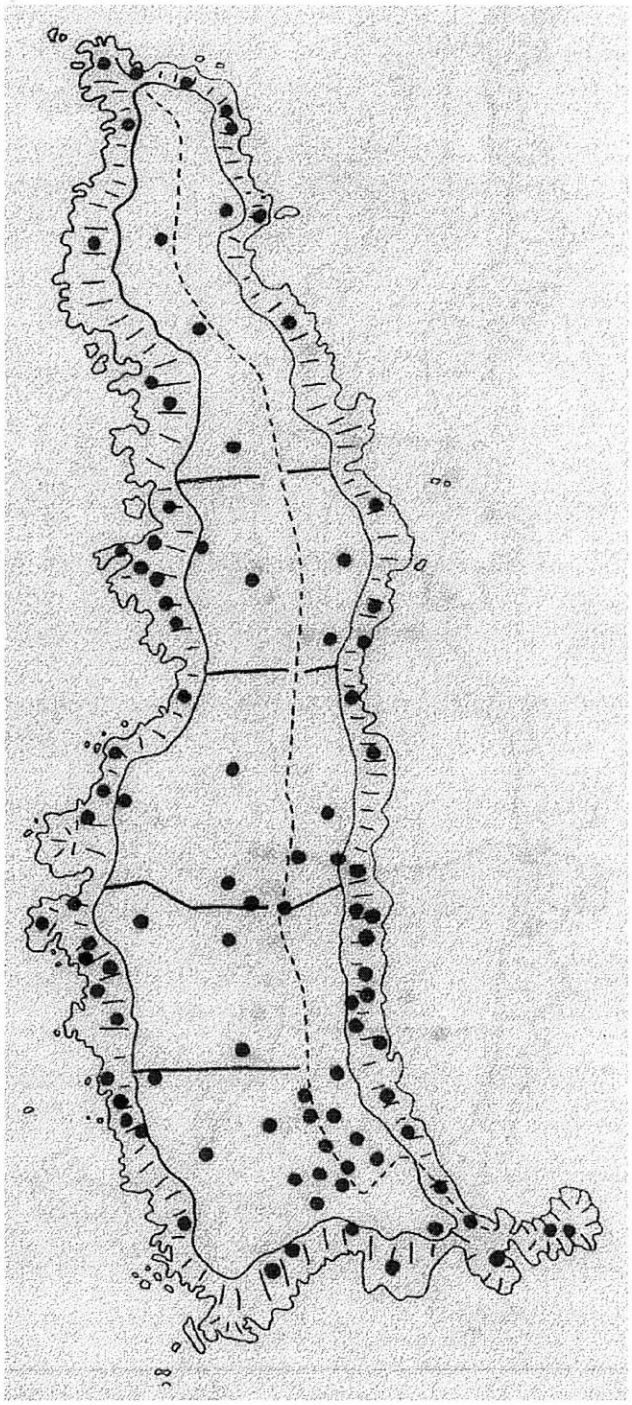

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