

THE SIZE OF THE BREEDING POPULATION OF  
MANX SHEARWATERS *PUFFINUS PUFFINUS* ON  
BARDSEY (WALES) IN 1996  
*HET AANTAL NOORDSE PIJLSTORMVOGELS BROEDEND  
OP BARDSEY (WALES) IN 1996*

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*In late May and early June 1996 a whole- island survey of Manx Shearwaters was undertaken on Bardsey. All apparently occupied burrows (AOB) were counted, resulting in a total of 6927 AOBs. An additional survey of shearwaters nesting amongst gorse bushes was carried out using a call playback technique and revealed an additional 101 pairs. A comparison of the accuracy of the two censusing techniques revealed a disparity of under 10% in a selected survey area. A future monitoring program for the Manx Shearwaters on Bardsey is proposed.*

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## INTRODUCTION

Bardsey is a small island of 179 ha. lying about 3 km off the Llyn peninsula in Gwynedd, Wales. It comprises three main physiographical areas: a hill rising to 167 m above sea level and sloping steeply to the sea on its western flank; a more fertile lowland zone (which, until recently, had been intensively farmed); and a mainly-bare southern promontory. Bardsey is a UK National Nature Reserve, where farming is an important conservation tool, although nowadays practiced much less intensively than in the past. Despite the importance of the Manx Shearwater *Puffinus puffinus* as a breeding species, few attempts have been made at a whole-island census. The objective of the work reported here was to obtain a good estimate of the total number of pairs of Manx Shearwaters breeding on Bardsey in 1996. By using repeatable methods the estimate obtained may be used as a baseline for monitoring future population trends.

## METHODS

The counting unit was the apparently occupied burrow (AOB). All fieldworkers were trained to identify and apply the criteria for assessing burrow occupancy: faeces and/or feathers at the entrance or inside; a smooth burrow floor

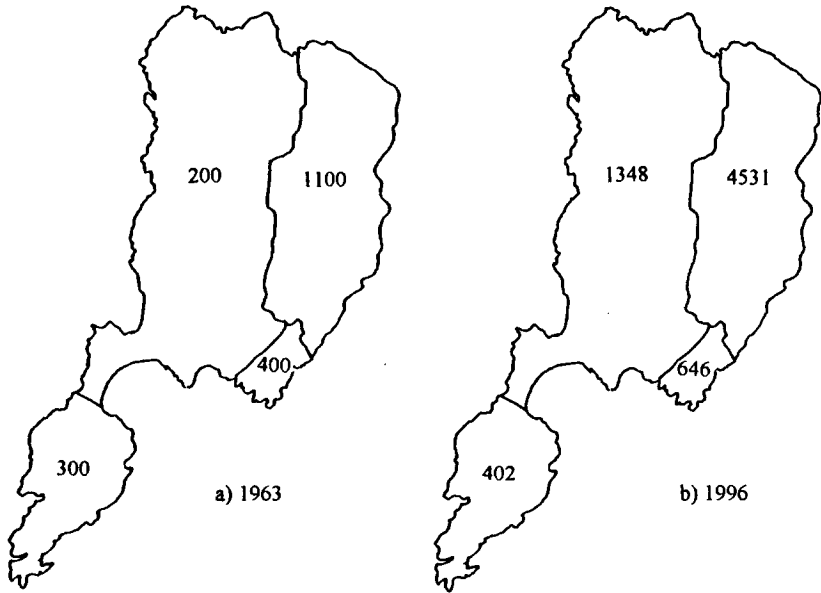


Figure 1. The numbers of Manx Shearwater AOBs on Bardsey by area in 1963 (a) and 1996 (b).

Figuur 1. Aantallen Noordse Pijlstormvogel (bezette holen) per deelgebied op Bardsey in 1963 (a) en in 1996 (b).

compacted by the waddling birds whose feet often left two worn grooves. A major complication was the presence of rabbit *Oryctolagus cuniculus* burrows, so a combination of the above features coupled with the absence of rabbit droppings formed the criteria for an AOB. For those occupied burrows that divided underground (where this could be seen), only one AOB was counted.

The survey was conducted between 20 May and 8 June 1996, a time when the shearwaters were incubating. This timing was considered to be optimum for two reasons: it was before the time when bracken *Pteridium aquilinum* growth would have made a count of AOBs impossible, and it was when prospecting and non-breeding birds visit a colony (Brooke 1990). The lowlands were counted relatively easily as most burrows are in the walls that separate the fields. Two surveyors walked on either side of the wall and examined each burrow. The AOBs along each stretch of wall were marked on a large-scale map. A check was then made of the open fields.

Table 1. Population estimates of Manx Shearwaters on the south end of Bardsey, using visual and call playback techniques (excluding areas of gorse) in 1996.

Tabel 1. Schattingen van de op de zuidpunt van Bardsey broedende aantallen Noordse Pijlstormvogels, gebruik makend van visuele technieken en afgespeelde geluidsopnames (met uitsluiting van een gebied bedekt met gaspeldoorn) in 1996.

| area gebied              | visual AOB count<br>telling van zichtbare holen | playback total<br>respons op geluid |
|--------------------------|---|-------------------------------------|
| open ground open terrein | 35  | 30                                  |
| walls muren              | 270   | 249                                 |
| total totaal             | 305   | 279                                 |

Table 2. Changes in numbers of Manx Shearwater AOB totals at different areas on Bardsey in 1963 and 1996.

Tabel 2. Verandering in het aantal bezette nestholen van Noordse Pijlstormvogels in verschillende delen van Bardsey in 1963 en in 1996.

| count zone telgebied | AOB total 1963<br>bezette holen, 1963 | AOB total 1996<br>bezette holen 1996 | % change 1963-96<br>verandering (%) |
|----------------------|---------------------------------------|--------------------------------------|-------------------------------------|
| west coast west kust | 200                                   | 1348                                 | 574%                                |
| mountain bergend     | 1100                                  | 4531                                 | 312%                                |
| Pen Christin         | 400                                   | 646                                  | 62%                                 |
| south end zuidkust   | 300                                   | 402                                  | 32%                                 |
| total totaal         | 2000                                  | 6928                                 | 246%                                |

Three fieldworkers who were allowed to clamber over the steep east face surveyed the entire mountain. Here the colonies are fairly small and distinct, being restricted to the areas of deeper soil. The surveyors were able to cover each area fairly easily by walking about 3 m apart, pointing out the burrows that they detected in order to prevent duplication. Once an area had been counted the number of AOB's was marked as accurately as possible on a large scale map. A series of paths and sheep tracks served as good boundaries to aid counting.

On Bardsey's lowlands, Manx Shearwaters often nest under low gorse *Ulex europaeus* bushes, burrowing into the densest part and nesting at ground level. In these areas, it is not possible to census using visual clues, so here the technique of James and Robertson (1985) was used. This entails playing a recorded male shearwater's call and recording any response. An attempt to test the accuracy of the AOB count against the call playback was made. The south

end was chosen as it is an easily demarcated area and has a large enough population to make reasonable comparisons.

## RESULTS

Figure 1b shows the recorded zonal distribution of the 6927 AOBs recorded. In addition, gorse areas yielded 51 responses to a taped recording. Applying the same correction factor (1.98) used by James and Robertson (1985) indicates an estimated 101 AOBs. On the south end the AOB count was 305, 35 in the open ground and 270 in the walls (see Table I). The corrected playback method estimated the south end population at 279 pairs, with 30 in the open ground and 249 in the walls.

## DISCUSSION

Comparison of 'visual' and 'playback' estimates revealed an approximate 9% difference. This suggests that the 1996 Bardsey figure of nearly 7000 pairs derived from the 'visual' method could be a slight overestimate. Two factors militate against complete accuracy: first, the small differences between observers; and second, the possibility of double occupancy of individual burrows that divided underground. Walsh *et al.* (1995) suggested that large colonies might best be surveyed using capture-recapture of chicks in burrows, but this might be difficult on Bardsey's terrain and with widely scattered burrows. There might be some inconsistency also in the 'playback' method. Smart (1986) showed the importance of the timing of the census in relation to the stage of breeding cycle; on her study area on Bardsey. A sample of 106 burrows elicited between 35 and 42 responses during a week in June, and between 22 and 42 responses during a week in July. Gibbons and Vaughan (1998) highlighted a potential flaw of the 'playback' method in that some responses to the taped call of a male appeared to be of the female type. This was also thought to have occurred in this study, although the results have not been amended. Roberts and Jones (1996) reported a count of shearwater burrows in the Bardsey lowlands in June 1995. His figure of 1425 burrows compares with 1279 for the same area in the 1996 survey, a 10% discrepancy possibly due to a slightly different method in assessing an AOB. Roberts and Jones (1996) counted all burrows that had any sign of shearwater use, whereas this study attempted to assess regular use.

The Manx Shearwater population on Bardsey was first documented in 1901 by Alpin (1902), and the first population estimate was made in 1913 by Ticehurst (1919), who estimated the size of the colony at 30-40 pairs on the northern slopes of the mountain. Between 1930 and 1952, estimates varied

between 100 and 1000 pairs (see Jones 1988). The Bardsey Bird and Field Observatory was established in 1953, but only one previous whole-island survey has been documented between then and present day. Pratt (1964) estimated 2000 pairs by counting apparently occupied sites, although the precise definition of these was not stated. Neither is the exact delimitation of Pratt's counting zone



known, but a comparison of 1963 and 1996 data is shown in Table II. Thus there are three main population estimates: 30-40 pairs in 1913, 2000 pairs in 1963 and 6928 pairs in 1996. Whatever the errors involved in these estimates, there has certainly been a considerable increase in the numbers of breeders on Bardsey during the twentieth century.

Some factors act to suppress population size. For example, there was probably some egg collecting on Bardsey earlier this century. Although the last cat was removed from the island in 1994, some shearwaters were killed by cats (and possibly also by ferrets) earlier than this. A few birds, both adults and juveniles, are killed annually by being attracted to the lighthouse, and Peregrines *Falco peregrinus* and Ravens *Corvus corax* predate some. The effect of gulls, if any, is unknown. Whereas egg collecting may have been significant when the population was small, other potential impacts are probably of little significance now that cats have been removed.

It is not known how the numbers of shearwaters interact with those of rabbits. Rabbits were clearly very common on the island in years prior to the mid-1950s but following the introduction of myxomatosis in the 1950s, their numbers have fluctuated dramatically with successive outbreaks. While rabbits and shearwaters do co-exist, even sharing burrow entrances, they are not mutually dependent, and there may occasionally be hostile interactions. Shearwaters can excavate their own burrows, but the ready availability of extra burrows during myxomatosis outbreaks might have benefited the birds, especially young, prospecting individuals.

The major change on Bardsey since the 1930s has been the large scale emigration of the human population and the demise of agricultural practice. Earth and stone walls in the lowlands have fallen into disrepair, so encouraging shearwaters to burrow there. Of the 1750 pairs of shearwaters currently breeding in the lowlands, 94% nest in the walls. On the island's south end, by contrast, the population increase between 1963 and 1996 was small, possibly due to the destruction of several walls and banks there in the early 1970s. Roberts' (1983) analysis of retrap data from Bardsey-ringed shearwaters, showed that an increase in numbers had taken place between 1978 and 1981, although the calculation of absolute numbers was not possible.

Clearly, the population increased between 1963 and 1996, but the lack of surveys in the intervening years does not allow the conclusion that the population is currently increasing. If population growth over the 33 years were constant this would give an annual increase of 3.9%. Assuming that the annual mortality is similar to that of 10% on Skokholm (Brooke 1990), annual recruitment to the colony would be in the order of 13.5%, which could be sustained by the Bardsey population alone. Interchange of birds between colonies appears to be a regular occurrence, the scale of which has not yet been

ascertained. Up to 1996, 45 Skokholm-ringed birds were controlled on Bardsey, with five from Skomer and seven from Copeland; of the Bardsey-ringed birds, eighteen were recorded on Skokholm, and seven each from Skomer and Copeland. The finding of a Skomer-ringed chick breeding subsequently on Bardsey indicates that this movement is not confined to non-breeders.

The population of Manx Shearwaters on Bardsey is clearly a major conservation asset, and an important constituent of the National Nature Reserve, so its status is a matter of concern to the island's managers. It is proposed that future surveillance should comprise the following activities: (a) whole-island census at 10 year intervals of AOBs as described in this paper; (b) census of sample areas every two years; (c) a study to establish the productivity of breeders in a sample area; and (d) the ringing of chicks. Additional information might include an annual record of land use and agricultural activity, number of rabbits, and observations of predation by gulls, corvids and birds of prey. With Bardsey's population of shearwaters higher than 33 years ago, there seems no reason to doubt that there is potential for further expansion, especially since there is good scope for breeders in the *c.* 25 km of earth and stone banks and in the patches of deeper soil on the mountain. Whatever the future holds, the establishment of a sound monitoring system is crucially important in the conservation of Manx Shearwaters on Bardsey.

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#### SAMENVATTING

Het eilandje Bardsey voor de kust van Wales is een natuurreservaat waar een kolonie Noordse Pijlstormvogels gevestigd is. Tot dusverre werd maar eenmaal eerder een poging ondernomen om de omvang van deze populatie vast te stellen met een integrale inventarisatie. Gekozen werd voor een methode die later gemakkelijk en precies herhaald kan worden en de veldwerkers werd geleerd hoe 'bezette nestholen' van pijlstormvogels (faeces en veren bij de nestingang en dikwijls duidelijk platgetreden grond met twee uitgesleten loopsporen van de binnenwaggelende vogels) kunnen worden onderscheiden van lege hopen en van konijnenholen. Op sommige plaatsen, waar de vegetatie het zicht op de grond ontnam, werden geluidsopnames afgespeeld om de aanwezige broedvogels een reactie te ontlokken. De inventarisatie werd uitgevoerd tussen 20 mei en 8 juni 1996, de periode waarin de Noordse Pijlstormvogels hun ei uitbroeden. Uit een test, uitgevoerd op de zuidpunt van het eiland, bleek de visuele methode tot iets hogere uitkomsten te leiden dan het afspelen van bandjes (9% verschil; Tabel 1). In totaal werden 6927 bezette hopen aangetroffen (Fig. 1). Ofschoon de visuele methode wellicht tot een overschatting van de populatie heeft geleid, is het duidelijk dat de kolonie op Bardsey sinds 1963 aanmerkelijk is gegroeid. Het broeden op Bardsey werd voor het eerst geconstateerd in 1901 (30-40 paren op de noordelijke hellingen) en schattingen tussen 1930 en 1953 varieerden van 100-1000 broedparen. Alleen in 1963 werd eveneens een volledige inventarisatie uitgevoerd en toen werd het bestand geschat op ongeveer 2000 paren.

Omdat er tussen 1963 en 1996 geen goede tellingen werden uitgevoerd is het onduidelijk of de kolonie tegenwoordig nog steeds groeit.

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