MANX SHEARWATER RECOVERY ON LUNDY: POPULATION AND DISTRIBUTION CHANGE FROM 2001 TO 2013

by

HELEN BOOKER[1] AND DAVID PRICE[2]

[1]RSPB, South West Regional Office, Keble House, Southernhay Gardens, Exeter, EX1 1NT

[2]8 Scattor View, Bridford, Exeter, EX6 7JF

Corresponding author, e-mail: helen.booker@rspb.org.uk

ABSTRACT

In the first week of June 2013 the breeding population of Manx Shearwaters on Lundy was surveyed using playback of calls, a repeat of the methodology from the previous surveys in 2001 and 2008. Response rates of incubating Manx Shearwaters to the played calls were also re-tested to maintain the accuracy of the population estimate. The growth of the island's Manx Shearwater population has been dramatic since the original survey in 2001: a tenfold increase since the eradication of rats a decade ago. The population now stands at an estimated 3,451 pairs.

Keywords: *Lundy, Manx Shearwater, population, calibration, rats*

INTRODUCTION

In 2001 a comprehensive survey of Manx Shearwaters on Lundy provided the first realistic population estimate for the island (Price and Booker, 2002). This first survey found a small population of Manx Shearwaters, which was considered to be far short of its potential given the size of the island and amount of available habitat. Shortly after, the Lundy Seabird Recovery Project, a partnership between English Nature (now Natural England), RSPB, National Trust and Landmark Trust, successfully eradicated rats from the island over the winters of 2002/3 and 2003/4 (Appleton *et al.*, 2006).

The first follow-up survey in 2008, after some five years of rat-free conditions on the island, reported a 250% increase in the number of Manx Shearwaters and a population estimate of 1,081 pairs (Booker and Price, 2010). In 2013, a further five years on and a decade since the bulk of the rat eradication was completed, the survey was repeated again. This paper describes the findings of the survey.

METHODOLOGY

As in 2001 and 2008, daytime call playback was used, employing the same recordings of calls of male and female Manx Shearwaters. Hand-held tape-recorders and, for the first time, an iPod and detachable speaker were used. The recording was played for up to 15 seconds at the entrance to all burrows and holes under large rocks or boulders. Surveyors recorded the number of holes checked and the number of apparently occupied burrows (AOBs) identified when a response from a sitting bird was received.

The survey period was 2 to 8 June, similar to that in 2008, when the survey was conducted in the last week of May and first week of June (an extended period due to poor weather). Coverage was also similar to allow a direct comparison of numbers and distribution. Additionally, the opportunity was taken to sample a small number of new areas with potentially suitable habitat which, for various reasons, were not surveyed in 2001 or 2008. However, for health and safety reasons, in 2013 the strip of habitat within five metres of the cliff edge was excluded. As part of the analysis, an adjustment in the number of AOBs was then made based on the proportion of birds that occupied this five-metre zone in 2008. As before, cliffs and unstable rock falls were avoided and the island plateau was surveyed selectively.

A team of ten surveyors were involved each day, with additional help from the island warden and assistants on various days. The weather was dry for the whole week, with sunshine and brisk easterly winds on most days. The survey took a full six days and part of a seventh day to complete. Even with this effort, parts of the east coast could not be covered, including the former rhododendron areas and the section between Brazen Ward and Gannets' Rock. These areas were considered as low priority based on a paucity of holes, and although sample transects were walked during 2001 and 2008, time constraints meant these areas could not be covered in 2013.

Along most of the coastal sidings, surveyors walked horizontal contour transects five metres apart, looking up the slope and checking burrows in the ground above their transect line to that of the next surveyor. In other places, such as steep, narrow gaps between rock buttresses, vertical transects were more efficient. Transects were followed by eye, though marker canes helped identify the right course, and sprigs of bracken placed in burrow entrances assisted accuracy by preventing double-checking of holes or missing holes altogether.

Response calibration and population estimate

When burrows are checked by playback, not all occupying birds will respond. To determine what proportion does respond, an area of burrows (a calibration plot) was selected and checked daily. The calibration plot was set up at the Old Light colony, the island's largest and most densely occupied area. One hundred and ten burrows were located and labelled with small pieces of individually numbered bamboo cane. Using experience from the 2008 survey, care was taken to avoid holes where errors and confusion could occur, e.g. where bird calls could be heard through more than one burrow entrance simultaneously. The calibration plot was set up a few days before the start of the main survey, on 30 May 2013.

Each burrow was checked daily for seven days until 5 June. At the end of this period the average daily response rate from all occupied burrows provided a percentage figure for the likelihood of a shearwater responding to the playback recording. Using this figure and applying it to the number of responses from the whole island this survey (including an estimate for the five-metre cliff-top strip) produced an overall population estimate for the number of breeding Manx Shearwaters on Lundy.

RESULTS

Occupied burrows and distribution

Across the whole island a total of 9,368 holes were checked for nesting shearwaters during the period 2 to 8 June. This compares to totals of 7,155 and 7,079 holes checked in 2001 and 2008 respectively. Taking into account comparable areas surveyed in 2008 and 2013, the number of holes are 6,400 and 8,500 respectively, representing an increase of more than 30%. From the 9,368 holes checked in 2013, 1,617 responses were obtained – a vast increase on the numbers recorded during the 2008 survey.

The distribution of occupied burrows reflected that recorded in 2001 and 2008, but with considerable population expansion in each area. Some new areas were discovered, specifically between North Light and Puffin Slope, just north of St Mark's Stone and immediately north of Old Light; these contributed an additional 113 occupied burrows. The only area to show a decline was a small site north of Long Roost, where seven birds were recorded in 2008 but only four in 2013 (though none was recorded in 2001). The island now supports relatively densely occupied areas along much of its west and north coasts. Figures 1 to 3 (pp.110-112) show the number and distribution of burrows from which responses were obtained in 2001, 2008 and 2013.

It should also be noted that the island wardens conducted a sample survey in a small area above Sugar Loaf, an area formerly covered in rhododendron, on 20 June, after the survey team had left, finding 14 holes but with no responses.

Population trends

As all three surveys used the same methodology, it is acceptable to use the number of responses obtained in each survey as a measure of population change. However, to compare the number of responses in 2013 with previous surveys, adjustments must be made to accommodate the small differences in coverage between the three surveys (including the exclusion of the lowest 5m in 2013). Table 1 presents these adjusted figures which show the huge growth in numbers over the period, and Figure 4 shows how the rate of population growth has increased post-2008.

	Adjusted Response Totals[1]			Percentage Increase
	2001	2008	2013	
2008-2013	–	528	1482	181%
2001-2013	136	–	1482	990%

[1] Adjustments made to ensure same coverage between the surveys being compared

Table 1: Population Trends between the 2001, 2008 and 2013 surveys

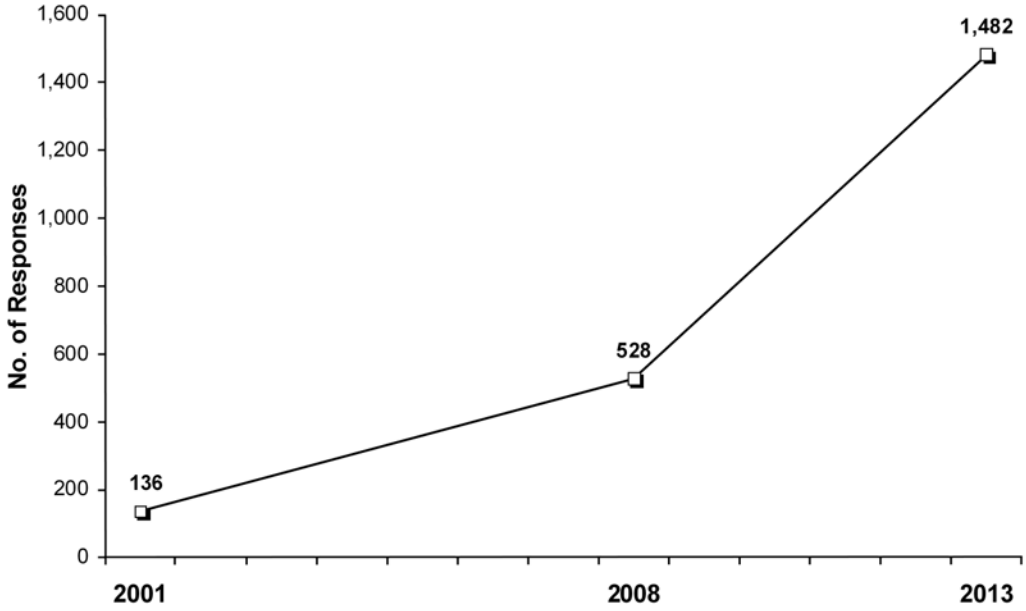

Figure 4: Overall population trend, 2001-2013

Calibration results and population estimate

As in 2008, marked burrows in the calibration area were checked daily for seven days. Only minor adjustments needed to be made for factors that could have caused inaccuracy, such as burrows that produced a double response (two birds calling from the same burrow). Figure 5 shows the pattern of responses over the seven days, producing an average rate of 32.3 responses each day; and Figure 6 shows the cumulative number of occupied burrows detected. At the end of the seven-day survey period, 63 of the 110 holes were found to contain nesting Manx Shearwaters.

It is apparent from Figure 6 that the number of occupied burrows was still rising at the end of the surveys, and there may have been additional occupied burrows which had not yet responded. Using the du Feu mark-recapture model (du Feu *et al.*, 1983) to investigate this situation provides an estimate of a further two occupied holes within the calibration area (which would have been discovered if the checking had continued for more than seven days). Table 2 shows how the response rate was derived from the pattern of recordings. Note that male birds are much more likely to respond to playback than females.

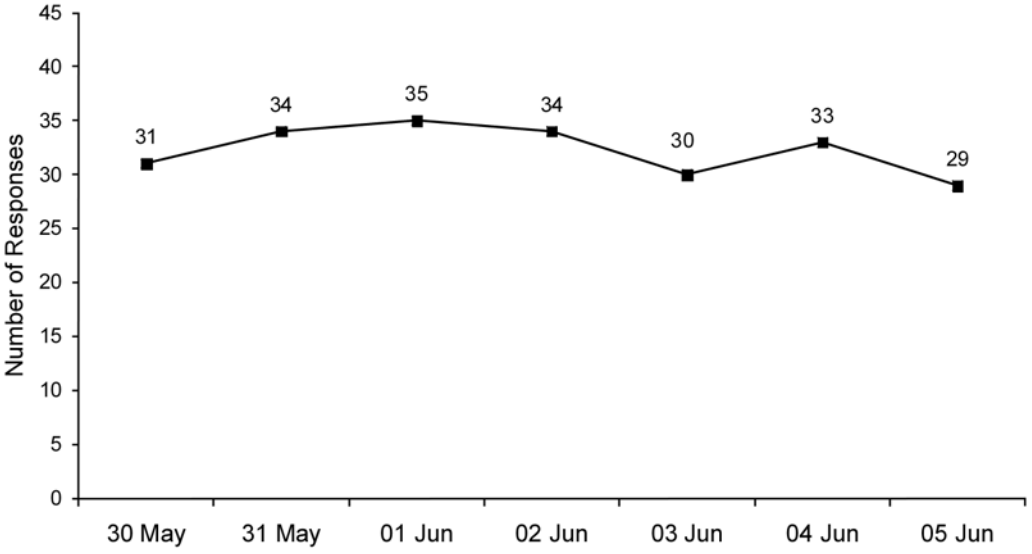

Figure 5: Number of responses per day

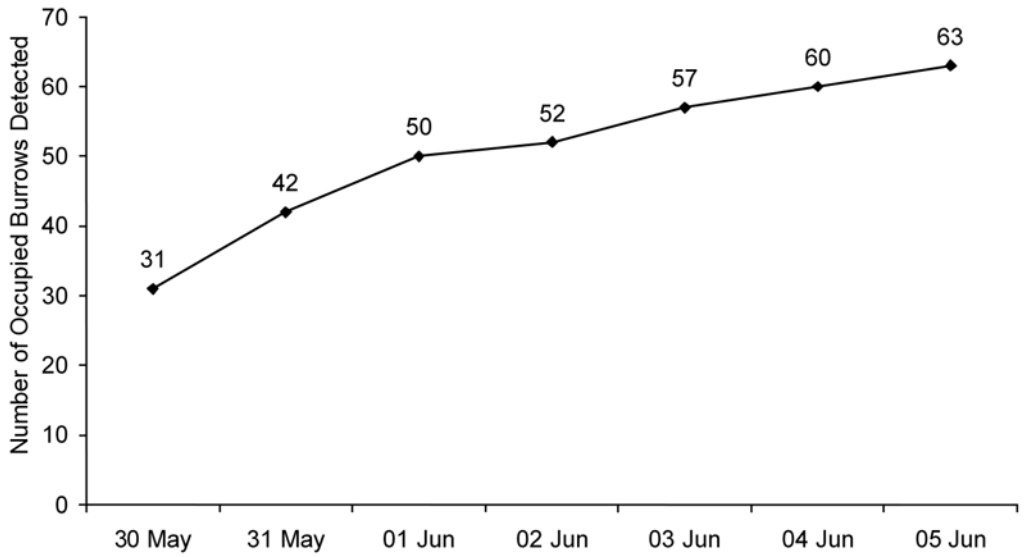

Figure 6: Cumulative number of occupied burrows detected

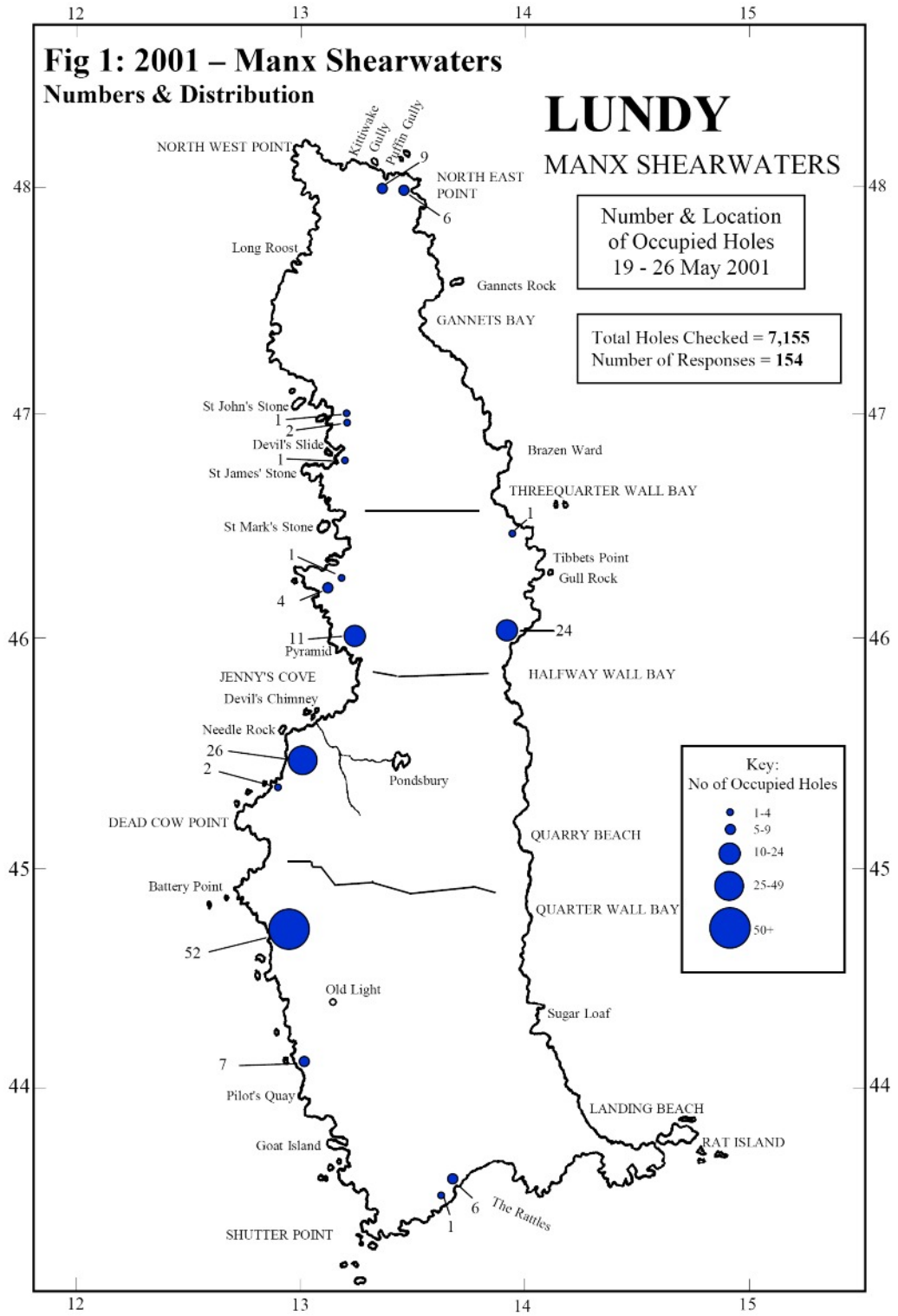

Figure 1: Manx Shearwater numbers and distribution, 2001

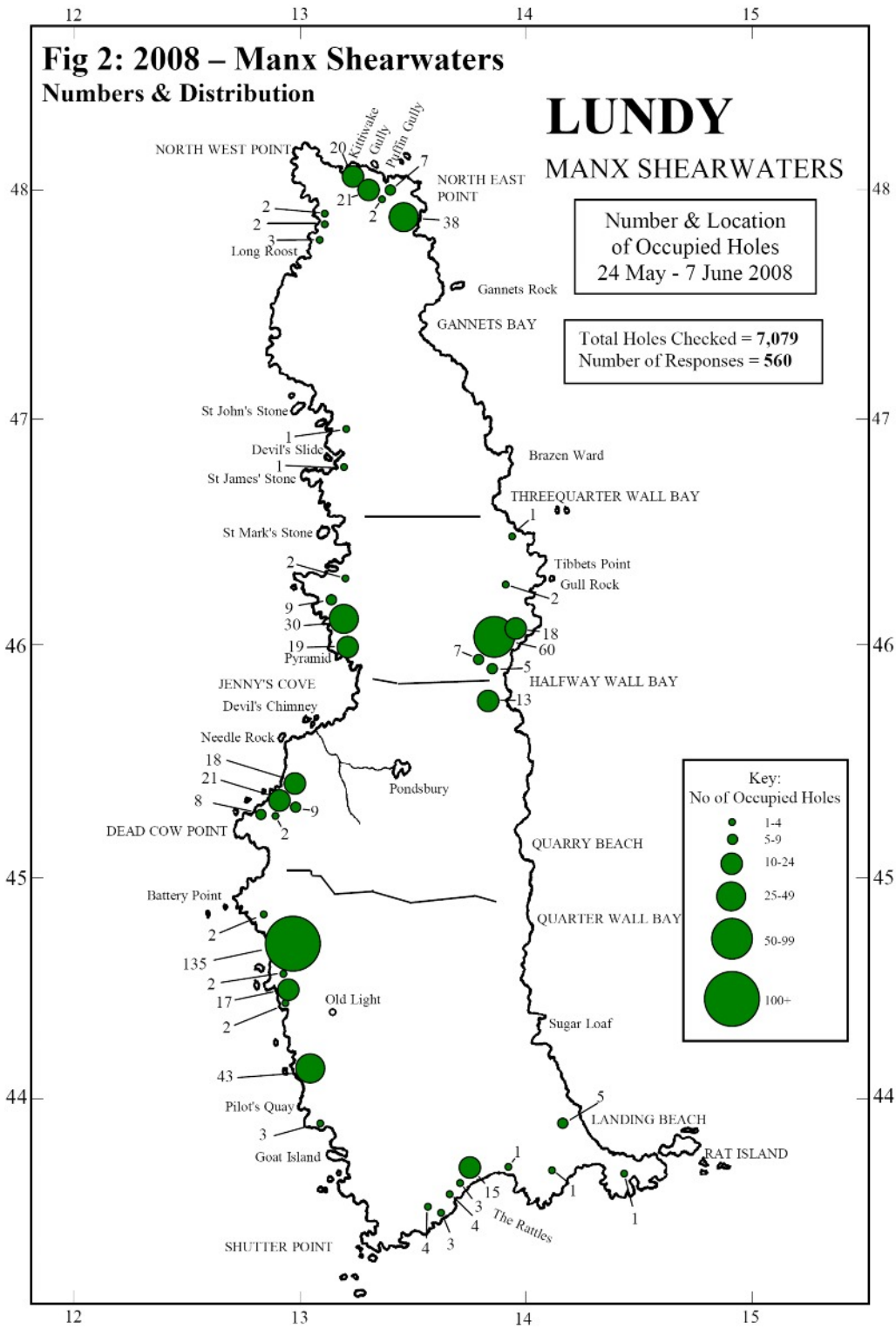

Figure 2: Manx Shearwater numbers and distribution, 2008

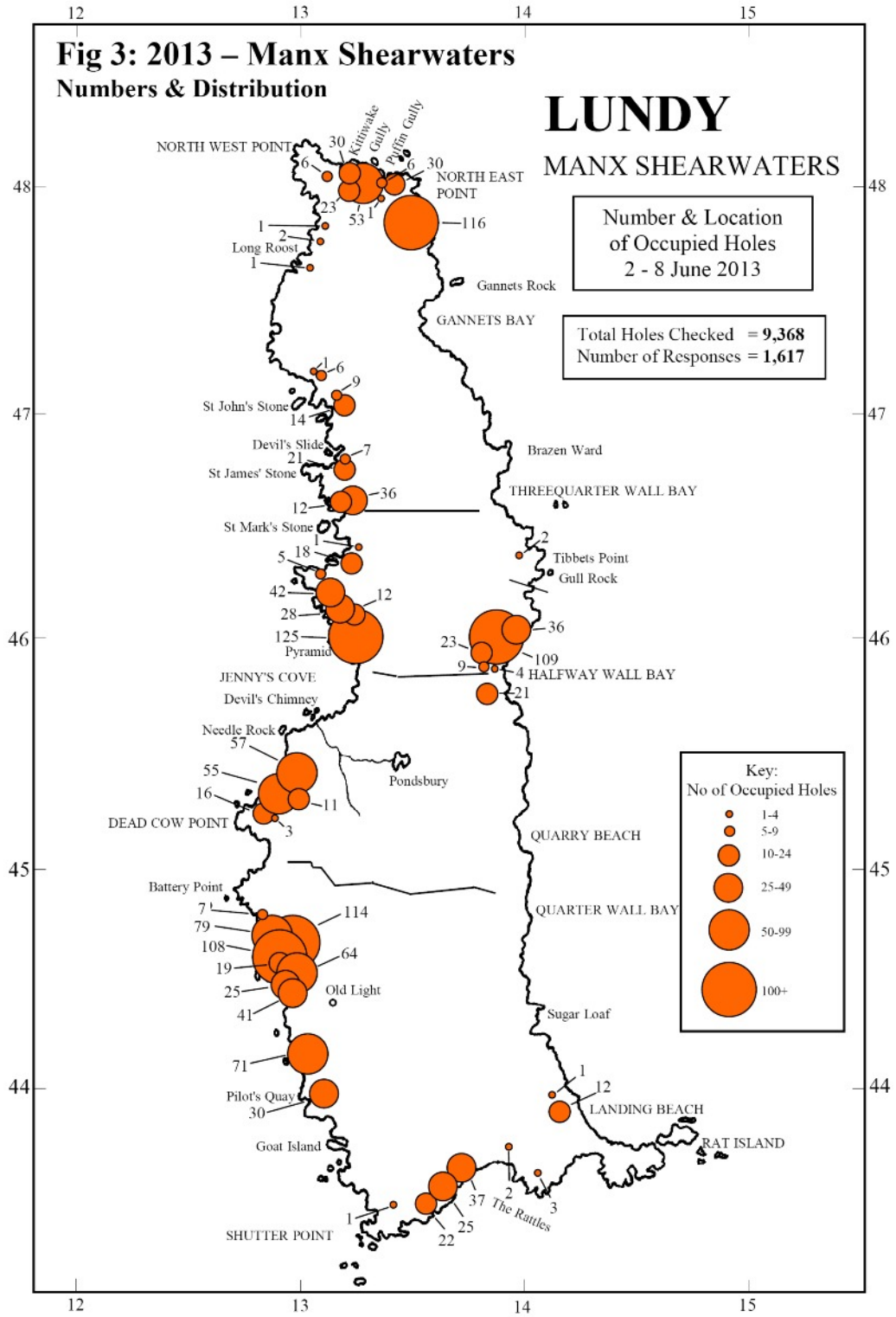

Figure 3: Manx Shearwater numbers and distribution, 2013

	30 May	31 May	01 Jun	02 Jun	03 Jun	04 Jun	05 Jun	Avge No. per Visit
No. of Holes Checked	110	110	110	110	110	110	110	
Male Responses	22	25	21	19	23	22	9	**20.1**
Female Responses	7	8	11	12	5	9	11	**9.0**
Indeterminate Responses	2	1	3	3	2	2	9	**3.1**
Total Responses	**31**	**3**	**35**	**34**	**30**	**33**	**29**	**32.3**
Cumulative Occupied Burrows	**31**	**42**	**50**	**52**	**57**	**60**	**63**	
Estimate of Total Occupied Burrows within Calibration Plot								**65**
Daily Response Rate at Occupied Burrows	48%	52%	54%	52%	46%	51%	45%	
Overall Daily Response Rate								**49.7%**

Note: Calibration survey initiated 3 days prior to the main survey

Table 2: Calibration details

The mean response rate of 49.7% indicates that, when checking holes, only half of the occupying birds will give a response. Thus, applying this response rate to the total number of responses obtained throughout the island (1,617) translates into an estimated population of 3,255 breeding pairs.

The 2013 survey excluded the lowest five metres of the sidings, which in 2008 contained 6% of occupied burrows. Assuming the distribution of breeding birds was similar, the number of responses in 2013 can be increased by 6% (195 pairs) to give an estimated total for the island of 3,451 breeding pairs.

DISCUSSION

The 2013 population estimate of 3,451 pairs is likely to represent a minimum total as there are areas of the island that are inaccessible and which therefore have never been surveyed. Within these areas the authors consider there is suitable breeding habitat, perhaps as much as 10% more, that could be occupied. Anecdotal evidence to support this was provided by the island warden when on 31 July 2013, while working at the jetty at night, around 30 Manx Shearwaters were seen entering burrows below the South Light, in an area inaccessible on foot (Beccy MacDonald, pers. comm.). These birds may have been breeding, or were immatures prospecting for future nesting sites, but they provide some indication that the population is higher than the survey team was able to measure.

It is also remarkable to appreciate that with over 9,000 holes checked and a population of over 3,000 nesting pairs, one in every three holes on Lundy contains a nesting Manx Shearwater.

The background to the phenomenal increase of 181% in the Manx Shearwater population in the five years since 2008, and a more than tenfold increase since 2001, is worthy of consideration. The initial increase between 2001 and 2008 was considered a response to the Lundy Seabird Recovery Project's action to eradicate rats from Lundy, though the scale of the increase was unexpected. This, and changes in other seabird populations on Lundy, were considered in detail by Brown *et al.* (2011), documenting the encouraging early signs of seabird recovery in the absence of rats.

The subsequent increase since 2008 is equally staggering, resulting in Lundy now holding over 1% of the UK population (3,000 pairs (Musgrove *et al.,* 2013)) and close to 1% of the global population (3,700 pairs (Mitchell *et al.,* 2004)).

Lundy now appears to be the seventh largest colony in the UK, behind Rum, Skomer, Skokholm, St Kilda, Bardsey and Ramsay, based on Seabird 2000 figures (Mitchell *et al.*, 2004) and recent post rat-eradication increases on Ramsay (Greg Morgan, pers. comm.).

The eradication of rats was undertaken over the winters of 2002/3 and 2003/4, with the vast majority of the island cleared during the first winter, giving the seabirds virtually rat-free breeding seasons from 2003 onwards. The typical age for first breeding of Manx Shearwaters is six years (Brooke, 1990). The increase in population in 2008 could therefore only be explained by successful immigration of birds reared at other colonies, most likely Skomer and Skokholm, though a bird that had been ringed on Copeland, Co. Down, was recaptured in August 2010 having relocated to Lundy (Brown *et al.*, 2011). Prior to the rat eradication, with no successful breeding on Lundy (Taylor, 1990), immigration was apparently only just maintaining the population at its low level. From 2009 onwards, birds reared on Lundy since 2003 would have been recruited into Lundy's breeding population, such that the 2013 survey includes five years of 'home-grown' breeding birds, as well as a proportion of continuing immigrants. Figure 4, showing the population trend over the 2001-2013 period, suggests that this is the case, with the steepness of the line increasing post-2008. In 2007, a study of the Old Light colony (Booker *et al.*, 2010) concluded that productivity was around 0.8 chicks per breeding pair (a figure similar to that in other rat-free colonies), and over the last three years the recapture of seven birds originally ringed as juveniles on Lundy confirms that they are successfully returning to breed.

The increase in the numbers of burrows checked is also of interest. Manx Shearwaters will occupy vacant chambers of a rabbit burrow or dig their own (Brooke, 1990). The increase in burrows found during the survey could be a reflection of the highest densities reached by the rabbit population but perhaps also the increasing numbers of birds, some of which could now be digging their own burrows, thereby increasing the overall availability of nest sites.

Figures 1, 2 and 3 graphically illustrate the change in distribution and numbers since 2001. The Old Light colony on the west coast remains the largest sub-colony with 301 responses recorded, indicating 642 breeding pairs. There are now sizeable concentrations

between Dead Cow Point and Needle Rock, and on the slopes north of the Pyramid, with smaller but significant concentrations developing from St Mark's Stone north to St John's Stone. With the exception of the Pyramid slopes, which held 11 AOBs in 2001, much of the colonisation of these areas has been recorded post rat eradication. At the north end of the island, there were also major increases at North East Point, in and around Puffin Slope and westwards towards the North Light.

On the east coast, apart from North East Point, the sub-colony at Tibbetts remains the main concentration, although the areas of cleared rhododendron on the southern half of the east coast could offer suitable nesting locations in years to come. The Tibbetts sub-colony has also increased substantially, but not quite to the same extent as in other areas, perhaps reflecting its position of relative isolation from other breeding sites on the island, or possibly the difficult terrain on the sidings where very dense bracken develops by July.

The number of AOBs on the south coast had risen from 32 in 2008 to 90 in 2013, the vast majority between Benjamin's Chair and Shutter Point. Interestingly, despite this big increase, the number of burrows checked in this area, particularly between the Castle and Benjamin's Chair, was much lower than in previous surveys. This area is a traditional rabbit colony but with the rabbit population currently at a low level, there was evidence of overgrown old burrows and no sign of newly excavated rabbit burrows. It would seem there is scope for further Manx Shearwater colonisation here in future years.

The increases recorded in the survey were far beyond expectations, raising the question of the likely further rate of recovery over the coming years. With such a rapidly growing population, it will be important to monitor the island's breeding Manx Shearwaters at regular intervals to accurately record the species' recovery and the rate of population change. It certainly appears that habitat and burrow availability will not be a limiting factor for many years. Maintaining a rat-free island will be critical to the ongoing recovery and future stability of Lundy's Manx Shearwaters.

The next planned survey of seabirds on Lundy will be as part of the next UK-wide, all-species seabird survey; the follow-up to Seabird 2000 (Mitchell *et al.,* 2004). Fieldwork for this is planned for the period 2015 to 2020. It will be fascinating to see if the current rate of population increase by Lundy's Manx Shearwaters is maintained.

CONCLUSIONS

Lundy's Manx Shearwater population is growing rapidly. The 2013 population is estimated at 3,451 pairs, an estimate that represents a tenfold increase in the population since the first survey in 2001. The population is now nationally important and almost at the level of international (global) importance and one of the most important UK colonies.

The eradication of rats appears to have enabled this tremendous growth in the population, due largely to immigration from other colonies, but also, since 2009, recruitment of Lundy-reared young back into the breeding population.

With one in three holes occupied by a nesting Manx Shearwater and still plenty of potential habitat to exploit, Lundy has the capacity to support a very large population, in the region of 10,000 pairs if all the current holes are occupied.

Even a very modest increase is likely to establish Lundy as one of the principal UK sites for what is globally one of its most important species.

Every effort should be made to ensure that biosecurity is maintained and that re-invasion by rats is prevented.

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