

TRESHNISH ISLES AUK RINGING GROUP

Manx  
Shearwater  
Census of the  
Treshnish Isles  
2018

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Photo credit: Andrew Carter



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## 1. Summary

- 1.1.1. In 2000, a survey of the numbers of Manx Shearwaters breeding on Lunga provided the first realistic population estimate for Treshnish Isles, 1,283 apparently occupied sites (Offer 2000). This report describes the findings of a second colony census using playback which in 2018 found a breeding population of Manx Shearwaters on Lunga estimated at 1,992 (1,840 - 2,172 at 95% CI) apparently occupied sites.

## 2. Introduction

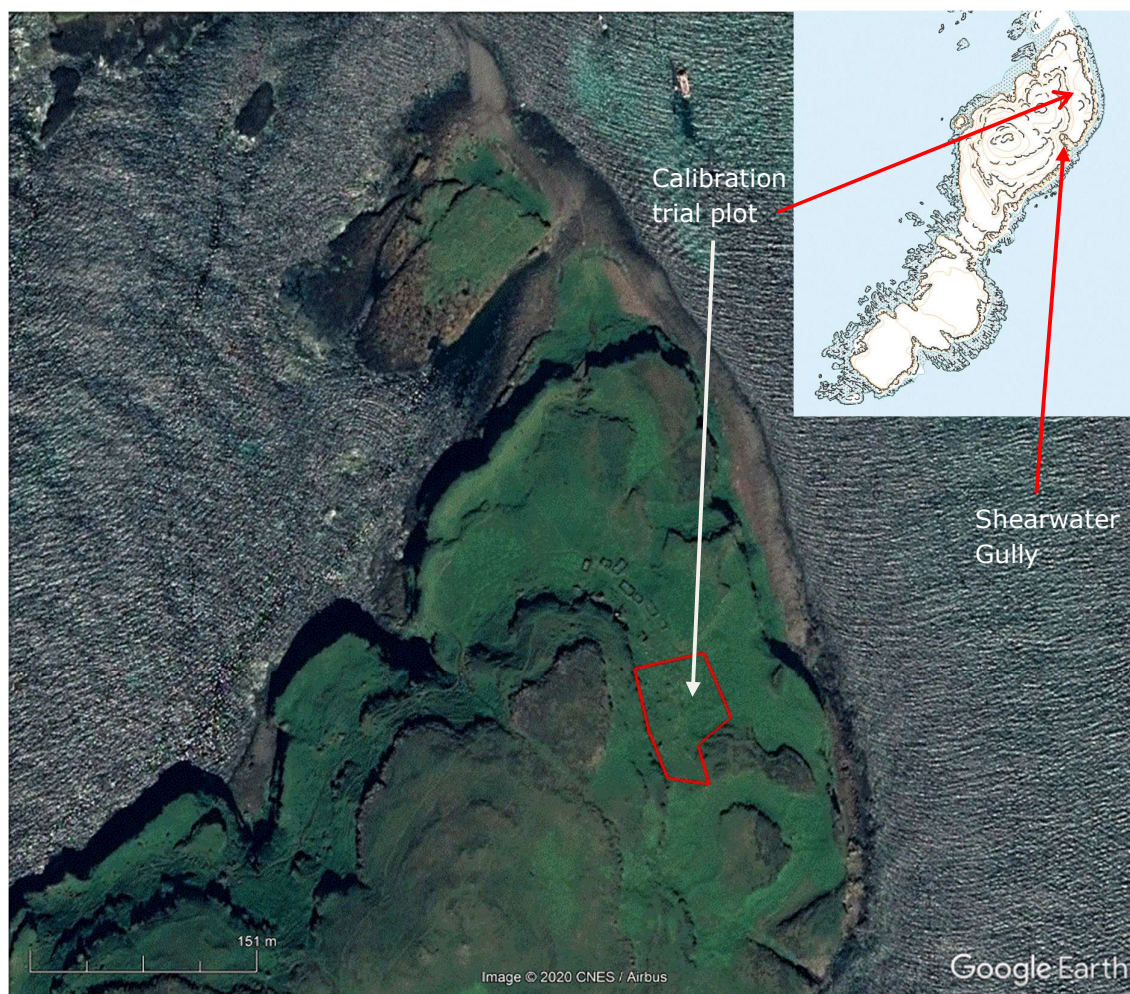
### 2.1 Population status

- 2.1.1. The colony of breeding Manx Shearwater *Puffinus puffinus* on the Treshnish Isles, south-west Scotland (56°29'N 06°25'W) is one of the breeding seabird assemblage features noted in the islands' designation as a Special Protection Area in 1994 under the EC Wild Birds Directive. Lunga is the largest of the Treshnish Isles, 69 ha in extent, and supports the main colony of breeding Manx Shearwater. Very few if any breeding birds of this species are considered to occupy the other islands, as little or no suitable habitat exists. Investigation of the other islands confirmed the absence of shearwaters where burrows were found; these were likely to be Rabbit *Oryctolagus cuniculus* or Puffin *Fratercula arctica* burrows (Offer 2000).
- 2.1.2. In 2000, a comprehensive survey of the numbers of Manx Shearwaters breeding on Lunga provided the first realistic population estimate for the island (Offer 2000). This first survey found a population of Manx Shearwaters on Lunga of 1,283 apparently occupied sites (AOS), which were more widespread in suitable habitat throughout the island than previously thought. Prior to this survey, the population had been estimated at around 600 pairs located mainly in the vicinity of Shearwater Gully (Figure 2-1) on the eastern side of Lunga (Offer 2000, Lloyd *et al.* 1991).
- 2.1.3. In 2018, a second comprehensive survey of the numbers of Manx Shearwaters breeding on Lunga was conducted. The aim of the survey was to provide an estimate of the numbers of breeding pairs of Manx Shearwater on the Treshnish Isles. This report describes the findings of the survey.

### 2.2 Censusing difficulties

- 2.2.1. Manx Shearwaters are a notoriously difficult breeding seabird to census owing to their nocturnal and burrow-nesting habits. Current guidance on seabird counting and monitoring techniques relevant to British and Irish colonies, recommends either of two methods for censusing Manx Shearwater (Walsh *et al.* 1995). Breeding colonies can be surveyed by counting burrows which show evidence of use or alternatively counting incubating adults by eliciting calls using diurnal playback methods. The use of diurnal playback methods at burrow entrances is however less subject to observer bias than compared with other ways of assessing burrow occupancy. Furthermore, diurnal playback methods obviate the potential for confusion with other burrow-nesting species, including Puffins and Rabbits, both of which occur together on the Treshnish Isles, and in particular Lunga.
- 2.2.2. In Britain and Ireland, the systematic application of playback during the Seabird 2000 census (mostly conducted in 1998–2002) gave the first national population estimates for Manx Shearwater (Mitchell *et al.* 2004). Most Manx Shearwater playback censuses in Seabird 2000 involved playing only the calls of males (Perkins *et al.* 2017), including that conducted on Lunga. Recent studies recommend that





**Figure 2-1** Location of calibration trial plot (outlined in red) on the island of Lunga (inset), Treshnish Isles, Argyll

- 2.2.3. the calls of both sexes should be used in playback surveys of Manx Shearwaters (Perkins *et al.* 2017). The implications for colony censuses using playback with dual-sex calls are it will elicit more responses during a single survey, resulting in improved detection of occupied burrows, giving a more accurate response rate and leading to more precise population estimates (Perkins *et al.* 2017).

## 2.3 Current census methods

- 2.3.1. The survey of Manx Shearwaters on Lunga in 2018, was conducted as part of the *Seabirds Count*, the fourth census of all breeding seabirds in Britain and Ireland, following on from Operation Seafarer (1969/70), the Seabird Colony Register (SCR; 1985-88) and Seabird 2000 (1998-2002). Manx Shearwater breeding colonies were surveyed for the *Seabirds Count* using two methods, taken from Walsh *et al.* (1995):
- counting burrows which show evidence of use
  - counting incubating adults by eliciting calls using taped calls during day-light hours
- 2.3.2. For the reasons discussed above (section 2.2.1), the comprehensive survey of Manx Shearwaters on Lunga in 2000 and 2018 were conducted using diurnal playback. The playback census method used was as recommended by Perkins *et al.* (2017).

## 2.4 Response probabilities

- 2.4.1. Diurnal playback as a method of censusing Manx Shearwaters will not detect every pair of breeding birds in a single visit (Soanes *et al.* 2012). Playback at a burrow entrance may fail to elicit a response because there may be no adult present in the burrow or the adult may fail to respond if present. It is therefore necessary to obtain a correction factor based on response probabilities in order to calculate the total population. Response rates are however variable between colonies and years, requiring calibration plots with daily visits for around one week to determine colony/year-specific response rates (Mitchell *et al.* 2004). Calculations for estimating a colony's population size (number of Apparently Occupied Sites, AOSs, which is the prescribed count unit for Manx Shearwater) involve multiplying the number of responses elicited from playback within a survey area by the reciprocal of the response rate. This correction factor accounts for unresponsive birds.
- 2.4.2. To increase the probability of obtaining responses to playback, the survey takes place at the peak of burrow attendance which is during the incubation period, which in Britain and Ireland is late May – early June (Walsh *et al.* 1995).

## 3. Study area

- 3.1.1. The Treshnish Isles is a group of eight terraced, Tertiary basalt islands (c.128 ha), together with three smaller vegetated islets and numerous skerries, situated at its closest 3 km west of Mull, N.W. Scotland (56°29'N 06°25'W). The Isles have been uninhabited by humans since 1834 and livestock since the 1980's. The survey of Manx Shearwaters was undertaken on Lunga, the largest of the Treshnish Isles, 69 ha in extent (Figure 2-1).



## 4. Methods

### 4.1 Survey team and timing



**Figure 4-1 Survey participants (left to right) Dennis Cooper, Ross Johns, Matt Williams, Robin Ward, Tim Dixon & Jamie Dixon with the photographer, Judith Ward**

4.1.1. Fieldwork was carried out between 27<sup>th</sup> May – 2<sup>nd</sup> June 2018 by a team of seven surveyors on the first day (Figure 4-1), and five thereafter (minus Robin & Judith Ward).

### 4.2 Correction for non-response to playback

4.2.1. To estimate a response probability a calibration trial plot representative of habitat occupied by Manx Shearwater on Lunga, was chosen where playback was repeated during the day for 7 days. The time of day of playback was varied. The burrows of breeding Manx Shearwater on Lunga cannot easily be inspected as the burrows are too deep, so the calibration trial was 'blind'. A total of 67 burrows considered to be burrows of breeding Manx Shearwater, were surveyed within the calibration trial plot. The calibration trial plot was located at the north end of Lunga and faced the sea to the east (Figure 2-1).

4.2.2. The calls of both sexes of Manx Shearwater were used in playback surveys as used by Perkins *et al.* (2017; Media File S2). At each burrow entrance a recording was played of both sexes intermixed for approximately 25 seconds (three to four call cycles per sex), followed by 10 seconds of silence to listen for delayed responses

(Figure 4-2). Each response was noted. The recording was played using a Neocore Wave A1 Portable Bluetooth Speaker (10 WATTS [2x5W stereo], Subwoofer).

- 4.2.3. On the first day of the calibration trial, the burrow entrance was numbered. Numbers were written with waterproof markers onto adhesive tape which was stuck to canes positioned beside the entrances. The markers were removed at the end of the calibration trial.



**Figure 4-2 Ross Johns conducting diurnal playback at a marked Manx Shearwater burrow within the calibration plot (photo: Robin Ward)**

- 4.2.4. For blind trails, Perkins *et al.* (2017) recommended surveys during the calibration trial should be conducted on successive days until no new response burrows are noted. Though conducting of the survey was constrained to seven days for logistical reasons, the lack of no new response burrows on the last day of the calibration trial is suggestive that the latter's duration was adequate.
- 4.2.5. The estimation of the number of AOS within the calibration trial plot was calculated using the du Feu mark-recapture method which makes full use of data on the number of burrows from which responses are repeatedly obtained during the trial (du Feu *et al.* 1983, Soanes *et al.* 2012).
- 4.2.6. For each estimate of the number of AOSs within the calibration trial plot, the mean daily response rate across all calibration surveys was calculated.
- 4.2.7. The reciprocal of the mean daily response rates provides the correction factor with which to derive a whole colony population estimate on multiplication with the



number of responses from the single visit playback survey of the whole island survey.

### **4.3 Whole island survey**

- 4.3.1. All potential Manx Shearwater breeding habitat on Lunga was surveyed once during daylight hours using the same method of call playback as for the calibration trial. The same recording and playback equipment were used as for the calibration trial. The response was noted.
- 4.3.2. The number of occupied burrows on Lunga surveyed in 2018 was estimated from the number of burrows from a response was elicited, multiplied by the correction factor for the respective method of calculation i.e. the du Feu mark-recapture method. 95% confidence intervals were estimated using a bootstrapping procedure (Bolton *et al.* 2010).

## **5. Results**

### **5.1 Calibration trial**

- 5.1.1. The calibration trial surveyed 67 burrows considered to be burrows of breeding Manx Shearwater, with the number of responses from each burrow surveyed presented in Appendix 1. The calibration trial recorded no responses for 11 of the 67 burrows. For 13 of the remaining burrows surveyed, the presence/absence of a response for one or more visits were not recorded (T.Dixon in litt.). As the incomplete datasets may compromise the statistical analysis, these 13 burrows have been excluded from the calibration trial plot.
- 5.1.2. The total number of occupied burrows (AOSs) was estimated within those sampled (54) to be 44.
- 5.1.3. The mean daily response rate was across all calibration surveys calculated as 0.549 giving a reciprocal correction factor of 1.82.

### **5.2 Whole island survey**

- 5.2.1. Between 27<sup>th</sup> May – 2<sup>nd</sup> June, 2,638 burrows were surveyed by playback on Lunga, and responses were obtained from 1,093.
- 5.2.2. Applying the correction factors to the number of responses obtained from Lunga gives an all-island estimate of 1,992 breeding pairs with 95% confidence intervals when estimated using a bootstrapping procedure of 1,840 – 2,172 pairs).

## **6. Discussion**

- 6.1.1. An estimated 1,992 breeding pairs counted in 2018 shows an increase of 55% to the numbers recorded on Lunga in 2000. The increase in Lunga's Manx Shearwater population since 2000 corresponds with trends of marked increases shown elsewhere at UK colonies which have been re-surveyed since Seabird 2000. The increase shown on Lundy from 201 to 5,504 AOS (in 2018) is attributed to the eradication of rats from the island, completed in spring 2004 (Booker *et al.* 2019). There has also been recent post rat-eradication increases in the breeding population of Manx Shearwater on Ramsay (Greg Morgan, pers. comm. cited in

Booker *et al.* 2019). Elsewhere, however, the underlying causes of population increases in breeding Manx Shearwater<sup>1</sup> is much less clear and needs to be better understood (e.g. Perrins *et al.* 2012), including on Lunga.

- 6.1.2. For Manx Shearwater alone, the estimated breeding population of 1,992 pairs on the Treshnish Isles represents approximately 0.5% of the World population, and therefore less than the species international importance 1% threshold (3,700 pairs; Mitchell *et al.* 2004). When however, the estimated breeding population of Manx Shearwater is taken together with that of the other populations of breeding seabird species that were surveyed in 2018 and 2019 (TIARG 2018, 2019), the Treshnish Isles exceeds international importance threshold for its total assemblage (over 20,000 breeding seabirds; JNCC 2020b).

## 7. Acknowledgements

- 7.1.1. The survey was organised by the TIARG whom would like to express appreciation to the owners of the Treshnish Isles, The Hebridean Trust ([www.hebrideantrust.org](http://www.hebrideantrust.org)) for permission to allow the Manx Shearwater census of the islands to be conducted. Scottish Natural Heritage are to be thanked for providing a grant to cover the cost of inter-island boat transportation necessary to undertake the survey.
- 7.1.2. We also thank Iain Morrison and his family, for continuing to provide our transportation between Mull and Lunga, and between the islands of the Treshnish Isles (<http://www.turusmara.com/>).
- 7.1.3. In addition, thanks are extended to Dr Mark Bolton, Ollie Padget and Dr Matt Wood for their guidance and assistance to the author with the data analysis.

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<sup>1</sup> i.e. population increases of 28% at Bardsey (20,675 AOS estimated in 2014–2016), 92% at Skokholm (89,000 AOS in 2018), 240% at Skomer (350,000 AOS in 2018), 430% at Middleholm (16,000 AOS in 2018) and 160% on the Isles of Scilly (523 AOS in 2015) to the numbers recorded during Seabird 2000 (JNCC 2020a, The Wildlife Trust of South & West Wales 2020).

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## Appendix A

### A.1 Responses recorded from Manx Shearwater burrows surveyed in the calibration trial, Lunga, in 2018

Date	Burrow number and responses*																																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
27 May	0	0	0	0	0	1	0	1	0	0	0	0	0	0		0	1	1	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0
28 May	0	0	0	0	0	1	0	1	1	1	1	1	0	1		0	1	1	1	0	0	0	0	0	0	0	0		1	1	0	0	0
29 May	0	1	0	0	0	1	0	1	1	1	1	1	0	1		0	0	1	1	1	0	0	0	0	0	0	1	0	1	1	1	0	0
30 May	0	0	0	0	0	0	0	0	0	1	1	1	0	1		1	1	1	1	0	0		0	0	0	1	0	1	0	1	0	0	0
31 May	0	0	0	1	0	1	0	1	1	1	0	1	0	0	1		1	0	0	0	0	0	1	0	0	1	0	0	1	1	1	0	0
1 June	0	0	1	0	0	0	1	1		1	1	1	1	0	1		1	1	0	0	0	0	1	1	0	1	0	0	1	1	0	0	0
2 June	0	0	1	0	0	0	0		1	1	1	1	1	0	1		1	0	0	1	0	0	1	1	1	1	0	0	1	1	0	0	0
Total no. of responses	0	1	2	1	0	4	1	5	4	6	5	6	2	3	3	1	5	5	4	2	0	0	3	2	2	6	0	3	6	7	1	0	0

\* 1 = responses, 0 = no response, blank = no data

Date	Burrow number and responses*																																			
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67		
27 May	1	0	0	1		1	0	0	1	1	0	0		1	1	0	0	0	0	0	1	0		1	0	0	0	0	0	1	1	1	1	1	1	
28 May	1	1	1	0		1	0	1	1	0	1	0	0	1	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	1	0	1	1	0		
29 May	1	1	0	1	0	1	0	0		1	1	0	1	1	1	0	1	1	0	0		0	0	0	0	0	0	0	1	1	0	1	1	0		
30 May	1	1	1	0	0	1	0	1	1	0	1	1		1	1	1			0	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0		
31 May	0	1	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1	1	1	
1 June	1	1	1	0	1	1	0	0	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	0	1	
2 June	1	1	1	1	1	0	0	1	0	0	1	1	1	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0	1	1	0	1	1	0	1	1
Total no. of responses	6	6	5	3	2	6	0	3	3	2	4	4	4	7	5	1	4	5	0	0	5	0	0	4	0	3	2	2	5	7	3	6	7	4		

\* 1 = responses, 0 = no response, blank = no data