ATLANTIC PUFFIN *(FRATERCULA ARCTICA)* POPULATION, DISTRIBUTION & PRODUCTIVITY ON LUNDY IN 2009 & 2010

by
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ABSTRACT
Numbers of breeding Atlantic Puffin *Fratercula arctica* on Lundy in 2009 and 2010 were estimated both from survey work and from LFS Logbook records, and the distribution of breeding birds was established. Productivity of Puffins was studied at two sites. In 2009, six pairs attempted breeding with a productivity of 0.5 young per breeding pair, and in 2010 there was a substantial increase to an estimated 16 breeding pairs with overall productivity of 0.44.

Keywords: *puffin, breeding, numbers, Lundy*

INTRODUCTION

Objectives

Land-based surveys of Atlantic Puffin *(Fratercula arctica)* numbers on Lundy have been ongoing for several years. The methodologies have been modified over the years to reflect the changes both in the number of Puffins present on Lundy and in their distribution.

This paper assesses the potential breeding population for the island as a whole in 2009 and 2010, and additionally presents the result of detailed studies of the two main breeding sites. These land-based surveys had the following aims:

- To assess the breeding population of Puffins at the two established breeding colonies
- To determine the distribution of breeding Puffins and monitor historic sites for evidence of breeding birds
- To estimate productivity of Puffins at the two established breeding colonies.

Background

The status of the breeding population of Puffins on Lundy has been uncertain for many years. The first systematic study took place in 1939 (Perry, 1940) and recorded an estimated 3,500 pairs. Population estimates over the subsequent 70 years have shown a major decline, with 129 birds in 1981 and a steady decline to just nine birds in 2003 (Davis & Jones, 2007).

The decline in Lundy's burrow-nesting seabirds, not only Atlantic Puffin but also Manx Shearwater *(Puffinus puffinus)*, prompted a full island survey of Manx Shearwaters in 2001 (Price & Booker, 2002), as a result of which the Lundy Seabird Recovery Project

was established in 2002 and rats were eradicated from Lundy in 2004. With Lundy's status as 'rat free', the Manx Shearwater population has thrived, with a 250% increase in breeding numbers in just five years (Booker & Price, 2010).

Since rat eradication, Puffin numbers also have been showing signs of recovery, albeit on a less dramatic scale. Observations since 2006 have indicated a slow but steady increase in numbers, with an estimated five breeding pairs in both 2007 and 2008 (Saunders & Wheatley, 2008, 2009). In 2008 a colony was re-established at Jenny's Cove where, prior to rat eradication, no land-based sightings had been recorded since 1992 (Price, 2004).

METHODS

Population assessment

Periodic whole-island surveys of all Lundy's breeding seabirds have taken place since 1981. Counts have been obtained for each species, with detailed definitions of all sites on Lundy. Each site comprises a description, a location map and viewing instructions detailed in the site register (Price, 2004). All Puffins seen are recorded, including those on the sea, which are allocated to the nearest land site suitable for breeding Puffins.

The whole-island census now takes place every four years, with the most recent in 2008. In addition to the four-yearly census, Puffin records from the LFS Logbook provide a valuable dataset for this species. Bird sightings are recorded numerically in Section One of the logbook, which gives daily observed counts reported by visitors. Judicious extraction of these records, particularly those prior to mid-June, can be used to estimate the population size.

In 2009 and 2010, surveys commenced on 14 April and 29 March respectively.

Breeding distribution

Colony observation surveys were carried out at two sites:

- St Philip's Stone - a north-facing slope just south of Threequarter Wall and St Mark's Stone (grid ref. SS 13034635)
- Jenny's Cove - a west-facing slope just north of the Devil's Chimney (grid ref. SS 13144575)[1]

These two sites are referenced as F4 and E8 in the Seabird Site Register (Price, 2004).

Observations at St Philip's Stone were made from a spur immediately to the north (grid ref. SS 13104640 - viewing point Fe) and for the Jenny's Cove site looking south from above the Pyramid (grid ref. SS 13144601 - viewing point Ei). All observations were made using 8x32 binoculars and a 48x60 telescope.

Site photographs were labelled with known burrows to aid comparison with data from previous surveys (Saunders & Wheatley, 2008). Breeding pairs were determined through burrow observations and the frequency of visiting Puffins, in accordance with the recommendations of the Seabird Monitoring Handbook (Walsh *et al.,* 1995). Surveys conducted later in the season determined breeding success by recording burrows into which birds were observed taking fish.

[1] All such subsequent alphanumeric codes of the form 'A9' relate to seabird sites in the Site Register, the initial letter (A-L) identifying the coastal section. References in the form 'Ab' refer to the location of observer viewing points.

Surveys were carried out at the two sites between March and July each year, with a total of 24 surveys in 2009 and 53 surveys in 2010. All Puffin behaviour was monitored to determine activity that would indicate breeding pairs and a summary of such activity was produced for each survey.

Productivity estimate

The basic method for assessing productivity is to identify a number of burrows occupied by breeding Puffins and to record successful or unsuccessful fledging, and from this to derive an average number of young per breeding pair. With burrow-nesting species where the nest itself is not directly visible, this obviously presents some challenges.

Additionally, the Seabird Monitoring Handbook recommends using a sample size of *c.*100 nest sites and including in the sample burrows entered by a Puffin on two separate dates. Surveying the population on Lundy therefore presents difficulties, as the guidelines are not specifically designed for such small colonies.

With fluctuating Puffin numbers on Lundy in recent years, a slow increase in breeding birds and visits to the colony by full-grown individuals not yet of breeding age, there are frequent investigations and explorations of burrows that are clearly not active nest sites. If every burrow entered on two occasions was included in our data set, it would result in a vast over-estimation of the number of breeding pairs. As a result, the observational data collected were subjected to critical scrutiny, and, for the purposes of this study, only burrows that were entered on two occasions before the end of May were assumed to be active nest sites and therefore included in the dataset, unless subsequent observations (such as apparent feeding of young) proved otherwise.

RESULTS

Population assessment

LFS Logbook records have been used to compare the 2009 and 2010 data with records from previous years. When all records are viewed as a scatter plot, the chart (Figure 1) clearly shows an increase in general abundance from 2007 to 2010, with a marked influx in late June 2010.

Where further details have been recorded by observers in Section Three of the logbook, the details have been extracted and summarised in Tables 1 and 2.

The four-yearly whole-island censuses are normally carried out during the first few days of June, before the assumed arrival of pre-breeding-age adults prospecting for possible future breeding sites. Logbook observations between 1 June and 6 June (observations in bold) have therefore been used to compare with historical data. Seven records were logged with sufficient detail to enable comparison in 2009 and nine records from the 2010 logbook. Each observation was grouped into the appropriate coastal section of the island A-L (Price, 2004). The maximum number of Puffins observed in each area at any one time was used to compare the number of Puffins on Lundy in 2009 and 2010 against previous years.

The total island figures in early June are illustrated in Figure 2 and Table 3, showing the numbers and distribution pattern of Puffins on Lundy between 1981 and 2010.

Table 1: Observations recorded in the LFS Logbook in 2009

Date	Number	Location	Observation	Survey Section
23-Apr-09	2	St Mark's Stone	on sea	F
08-Apr-09	2	St Philip's Stone	burrows E & I	F
10-Apr-09	1	St Philip's Stone	on sea	F
10-Apr-09	3	Jenny's Cove	on land burrows B & A	E
11-Apr-09	5	Jenny's Cove	4 on land, 1 on sea	E
13-Apr-09	1	St Philip's Stone	burrow C	F
13-Apr-09	8	Jenny's Cove	3 pairs, A B & E all collecting nest material	E
17-Apr-09	6	Jenny's Cove	on sea	E
17-Apr-09	8	St Philip's Stone	7 on sea, 1 at burrow E, 2 at M	F
17-Apr-09	3	St Philip's Stone	2 at C and 1 at M	F
19-Apr-09	1	St Philip's Stone	1 at D	F
19-Apr-09	8	Jenny's Cove	7 at sea and one at F	E
20-Apr-09	4	St Philip's Stone	2 at E, 1 at D	F
20-Apr-09	10	Jenny's Cove	A, 2B, 2E, 2F	E
21-Apr-09	6	St Philip's Stone	2D, 2C, 2M	F
21-Apr-09	9	Jenny's Cove	2E, 2F, 2G, 2A, 1B	E
27-Apr-09	7	Jenny's Cove	at burrows	E
29-Apr-09	7	Jenny's Cove	5 at burrows, 2 on sea	E
04-May-09	1	Jenny's Cove	on sea	E
05-May-09	5	Jenny's Cove		E
07-May-09	4	Jenny's Cove	at burrows	E
07-May-09	8	Jenny's Cove		E
07-May-09	8	Jenny's Cove	at burrows	E
17-May-09	2	Jenny's Cove		E
17-May-09	1	St Philip's Stone		F
18-May-09	5	St Philip's Stone		F
21-May-09	8	Jenny's Cove	on land	E
22-May-09	7	Jenny's Cove	on land	E
24-May-09	2	St Philip 's Stone	at burrows	F
24-May-09	1	Jenny's Cove	at burrows	E
25-May-09	2	Jenny's Cove	on land	E
25-May-09	1	Jenny's Cove	On land to S of Devils Chimney	E
28-May-09	12	Jenny's Cove	8 on land 4 at sea	E
30-May-09	7	Jenny's Cove	on sea	E
30-May-09	2	St Philip's Stone	on land	F
30-May-09	7	Jenny's Cove	on sea	E
01-Jun-09	6	Jenny's Cove	on sea	E
02-Jun-09	**2**	**South of Rat island**	**on sea**	**A**
02-Jun-09	**1**	**Brazen Ward**		**K**
04-Jun-09	**10**	**Jenny's Cove**	**on sea**	**E**
10-Jun-09	**3**	**Benjamin's Chair**	**on sea**	**A**
11-Jun-09	**7**	**Gannets' Rock**	**on sea**	**I**
11-Jun-00	**12**	**Devils Chimney**	**on land**	**E**
12-Jun-09	**4**	**off SW point**	**on sea**	**B**
16-Jun-09	5	north Gannets' Rock	on sea	I
17-Jun-09	6	Jenny's Cove		E
19-Jun-09	11	Jenny's Cove		E
21-Jun-09	4	SW Point		B
28-Jun-09	12	Jenny's Cove	on land	E
29-Jun-09	1	NE point	on sea	H
01-Jul-09	3	Gannets' Rock	on land	I

Table 2: Observations recorded in the LFS Logbook in 2010

Date	Number	Location	Observation	Survey Section
23-Mar-10	3	Jenny's Cove	On water	E
26-Mar-10	3	Jenny's Cove	On water & 2 on land	E
27-Mar-10	4	St Philip's Stone	2 on water, 2 at burrow C	F
29-Mar-10	5	Jenny's Cove	2 on land & 3 on water	E
31-Mar-10	6	Jenny's Cove	On water	E
01-Apr-10	2	Jenny's Cove	On water	E
13-Apr-10	9	Jenny's Cove		E
04-May-10	4	St Philip's Stone		F
06-May-10	8	Jenny's Cove	On land	E
06-May-10	5	Jenny's Cove		E
10-May-10	6	Jenny's Cove	3 on water, 3 on land	E
10-May-10	2	St Philip's Stone	On land	F
25-May-10	2	Jenny's Cove	On land	E
26-May-10	4	Jenny's Cove	On land	E
31-May-10	5	Jenny's Cove	On water	E
01-Jun-10	**10**	**Btwn Quarry Beach and Knoll Pins**		**L**
02-Jun-10	**4**	**Jenny's Cove**	**On land**	**E**
02-Jun-09	**5**	**North End**		**H**
03-Jun-09	**2**	**Long Roost**		**G**
03-Jun-10	**2**	**St Philip's Stone**		**F**
04-Jun-09	**11**	**Jenny's Cove**		**E**
04-Jun-10	**4**	**North End**		**H**
06-Jun-10	**14**	**Jenny's Cove**		**E**
06-Jun-10	**3**	**St Philip's Stone**		**F**
07-Jun-09	14	Jenny's Cove		E
07-Jun-10	4	NE Point		I
10-Jun-09	18	Jenny's Cove		E
11-Jun-09	8	Jenny's Cove		E
11-Jun-10	3	Brazen Ward	On water	K
11-Jun-10	20	Gannets' Bay	On water	J
13-Jun-10	27	Gannets' Rock		I
13-Jun-10	4	Brazen Ward		K
13-Jun-10	7	St Philip's Stone		F
14-Jun-10	20	St Philip's Stone	17 on water, 3 on land	F
14-Jun-10	25	Jenny's Cove	On land	E
14-Jun-10	15	Benjamin's Chair	On water	A
15-Jun-10	6	Benjamin's Chair		A
18-Jun-10	8	St Philip's Stone	On land	F
18-Jun-10	13	Benjamin's Chair	On water	A
08-Jun-10	8	Landing Bay	In flight	L
24-Jun-10	33	Jenny's Cove		E
24-Jun-10	4	St Philip's Stone		F
24-Jun-10	5	Gannets' Rock		I
24-Jun-10	1	South East		L
25-Jun-10	50	Jenny's Cove	On land	E
25-Jun-10	6	St Philip's Stone		F
21-Jul-10	3	Jenny's Cove		E

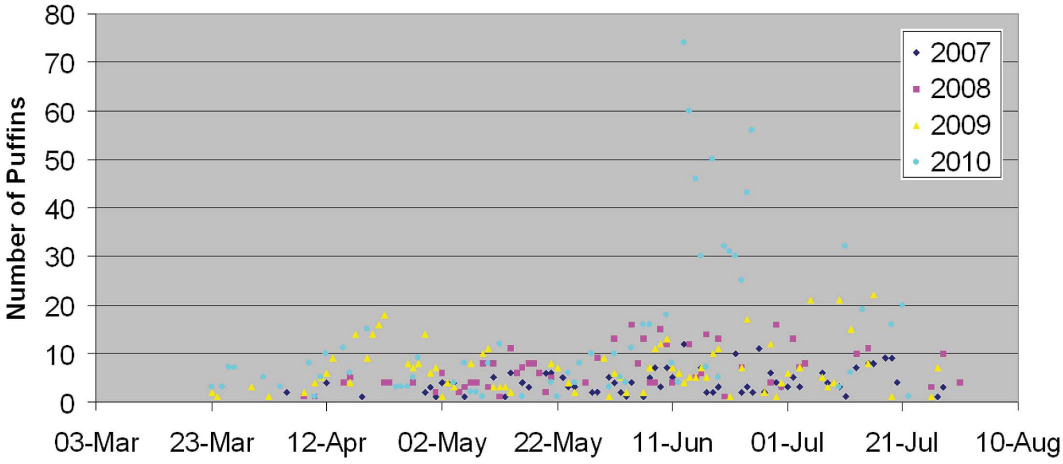


Figure 1: Log book puffin numbers 2007-2010

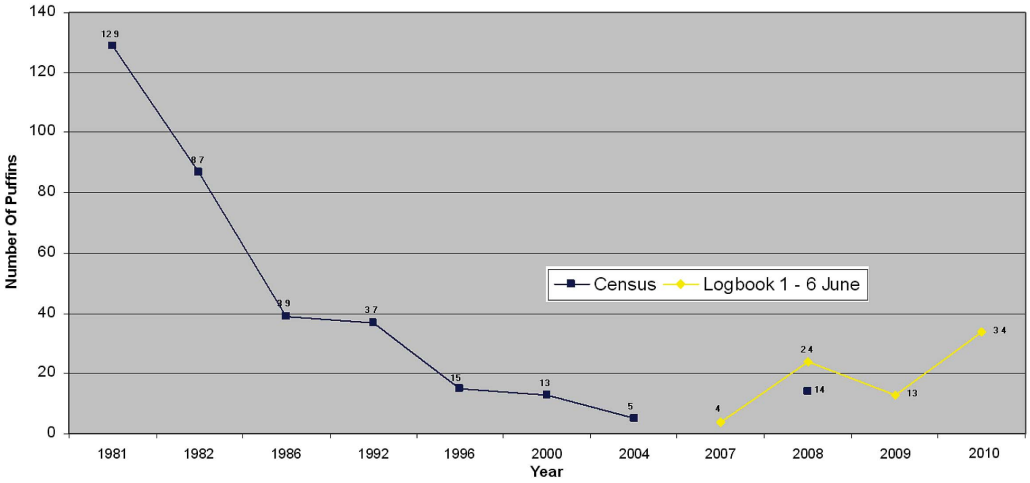


Figure 2: Maximum number of Puffins recorded on Lundy in early June

Table 3: Puffin Numbers recorded on and around Lundy in early June between 1981 and 2010

Study Plot		1981	1982	1986	1992	1996	2000	2004	2007	2008	2009	2010
A	South Light to Shutter Rock									6	2	
B	Shutter Point to Old Light											
C	Old Light to Battery Point											
D	Battery Point to Needle Rock	34	18	8	1	1						
E	Needle Rock to Pyramid	31	35	12	13		2			6	10	14
F	Pyramid to St James Stone	8	3	10	7	1	5	5	4	8		3
G	St James Stone to NW Point	47	20	7	10	13	5					2
H	NW Point to NE Point	5	6	2	5		1			1		5
I	NE Point to Gannets Rock	4	5							3		
J	Gannets Rock to Brazen Ward				1							
K	Brazen Ward to Halfway Way											
L	Halfway Wall (East) to South Light											10
	Total	**129**	**87**	**39**	**37**	**15**	**13**	**5**	**4**	**24**	**12**	**34**

Direct comparisons between the census (blue) and the log entries (yellow) should be made with caution, due to the variation in the methodologies used to obtain the data.

It should be noted that many of the sightings recorded in the logbooks (Tables 1 and 2) were of birds on the water. As such, it is less likely they can be assumed to be breeders. Therefore, logbook entries can be a useful tool for monitoring general trends over the years, but the counts derived from the logbooks for early June should not be taken as entirely reflective of the island's breeding population.

Site observations at the beginning of June from Jenny's Cove and St Philip's Stone produced a total of 18 Puffins (11 and seven birds respectively), which compares with an estimate of 34 from the logbook records.

Breeding distribution

The first land-based sighting in 2009 was on 17 April at St Philip's Stone and, in 2010, on 1 April in Jenny's Cove, although it was a further 11 days until the next land sighting in 2010, again at Jenny's Cove, on 12 April.

St Philip's Stone F4

15 burrows were identified at St Philip's Stone (F4) in 2009 and 2010 (A-O).

Table 4 provides a summary of survey results for St Philip's Stone in 2009. Activity was observed at seven different burrows during the survey period. A potential new burrow was identified at $_{F4}$O where Puffins were observed entering on two occasions before the end of May. There was clear evidence of pair bonding, with billing and burrow preparation and collection of nest material.

Burrow $_{F4}$M got off to a promising start with two early burrow visits in April, but no further activity was recorded.

Four burrows $_{F4}$A, $_{F4}$C $_{F4}$E & $_{F4}$O were occupied by birds for extended periods, while burrows $_{F4}$B, $_{F4}$D & $_{F4}$M showed infrequent activity.

Table 5 summarises results from surveys at St Philip's Stone in 2010.

The number of birds at St Philip's Stone appeared to decline in 2010, with just two burrows, $_{F4}$C & $_{F4}$E, apparently permanently occupied, a single observation of a pair at $_{F4}$A, and sporadic observations of a solitary bird at $_{F4}$D.

Jenny's Cove E8

In 2009, nine burrows (A-I) were identified at Jenny's Cove (E8) and 13 burrows (A-M) identified in 2010

Summaries of results for Jenny's Cove surveys in 2009 and 2010 are shown in Tables 6 and 7 respectively.

In 2009 activity was recorded at nine burrows in Jenny's Cove, five of which were occupied throughout the season. While St Philip's Stone saw a reduction in activity in 2010, the Jenny's Cove colony saw a marked increase, with activity recorded at 13 separate burrows and an influx of individuals in late June. 32 Puffins were seen at once on E8 on 24 June and on 25 June a record 50 individual birds were seen at Jenny's Cove (33 at E8 and the remainder on land at various locations within the site).

Table 4: Summary of Results for St. Philip's Stone (F4) in 2009

Survey number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
		14-Apr-09	16-Apr-09	17-Apr-09	21-Apr-09	22-Apr-09	23-Apr-09	29-Apr-09	03-Apr-09	10-May-09	13-May-09	08-Jun-09	16-Jun-09	24-Jun-09	04-Jul-09	07-Jul-09	08-Jul-09
Observation Effort (in hrs)		00:40	01:00	01:00	00:40	00:45	01:00	00:45	00:20	01:00	00:45	01:00	02:00	02:00	01:00	01:30	00:35
Start Time		13:40	08:30	15:50	18:20	07:45	15:45	17:55	15:55	15:00	07:55	08:10	07:10	17:25	06:10	06:45	17:25
End Time		14:20	09:30	16:50	19:00	08:30	16:45	18:40	16:15	16:00	08:40	09:10	09:10	19:25	07:10	08:15	18:00
Confirmed burrow Activity	$_{F4}$A	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	1
	$_{F4}$B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	$_{F4}$C	0	0	0	0	0	0	1	0	1	0	0	1	2	2	2	2
	$_{F4}$D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	$_{F4}$E	0	0	1	0	0	0	0	0	2	1	1	1	2	1	2	2
	$_{F4}$F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$M	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$O					2				0	2N	2	3D	2B	0	2	1

Table 5: Summary of Results for St. Philip's Stone (F4) in 2010

Survey number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	23	24	25
		29-Mar-10	01-Apr-10	05-Apr-10	09-Apr-10	12-Apr-10	15-Apr-10	19-Apr-10	23-Apr-10	03-May-10	07-May-10	10-May-10	17-May-10	20-May-10	24-May-10	27-May-10	19-Jun-10	24-Jun-10	25-Jun-10	27-Jun-10	28-Jun-10	08-Jul-10	12-Jul-10	21-Jul-10	23-Jul-10
Observation Effort (in hrs)		01:00	00:30	00:50	00:30	01:10	01:00	00:45	01:00	01:00	01:00	01:00	01:40	01:00	00:45	01:00	01:00	01:00	01:00	01:00		01:05	01:00	01:15	00:25
Start Time		15:00	09:15	08:55	18:00	09:00	09:25	07:30	16:00	08:30	16:20	09:00	10:10	15:45	10:30	17:15	14:50	10:50	10:30	09:30		14:35	10:30	09:30	10:00
End Time		16:00	09:45	09:45	18:30	10:10	10:25	08:15	17:00	09:30	17:20	10:00	11:50	16:45	11:15	18:15	15:50	11:50	11:30	10:30		15:40	11:30	10:45	10:25
Confirmed burrow Activity	$_{F4}$A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
	$_{F4}$B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$C	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	2	2	2	F	0	1C	0	0
	$_{F4}$D	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
	$_{F4}$E	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	2	2	1	1	F	2F	1	3	0
	$_{F4}$F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$H	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$_{F4}$O	0	0	0	0	0	0	1	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0

Table 6: Summary of Results for Jenny's Cove (E8) in 2009

Survey number		1	2	3	4	5	6	7	8	9	10	11	12
		14-Apr-09	22-Apr-09	23-Apr-09	28-Apr-09	03-May-09	21-May-09	08-Jun-09	01-Jul-09	05-Jul-09	09-Jul-09	10-Jul-09	16-Jul-09
Observation Effort (in hrs)		00:40	00:30	01:00	01:00	00:20	00:30	00:40	02:00	02:00	02:00	02:00	01:00
Start Time		12:50	08:45	14:30	16:15	16:30	15:00	11:20	17:35	06:00	16:30	06:20	08:10
End Time		13:30	09:15	15:30	17:15	16:50	15:30	12:00	19:35	08:00	18:30	08:20	09:10
Confirmed burrow Activity	E8A	0	1	0	0	0	1	2	1	2	0	1	1
	E8B	0	1	0	2	0	1	2	1F	2	2F	2	1
	E8C	0	0	0	1	0	0	0	0	0	0	0	0
	E8D	0	0	0	2	0	0	0	0	2	0	0	0
	E8E	0	0	0	0	0	2	1	2	2	2	2	2
	E8F	0	2	0	2	0	2	2	1F	0	2	2F	2
	E8G		1	0	0	0	2	1	1F	2F	1	1	1
	E8H							1	0	2	0	2	1
	E8I							1	0	0	0	1	1

Table 7: Summary of Results for Jenny's Cove (E8) in 2010

Survey number		1	2	3	4	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
		29-Mar-10	01-Apr-10	05-Apr-10	07-Apr-10	09-Apr-10	12-Apr-10	15-Apr-10	19-Apr-10	23-Apr-10	27-Apr-10	03-May-10	07-May-10	10-May-10	17-May-10	20-May-10	24-May-10	27-May-10	03-Jun-10	14-Jun-10	18-Jun-10	24-Jun-10	25-Jun-10	27-Jun-10	08-Jul-10	11-Jul-10	12-Jul-10	21-Jul-10	23-Jul-10
Observation Effort (in hrs)		00:25	00:30	00:30	01:00	01:00	01:00	01:00	00:45	01:00	01:00	01:00	01:00	01:00	00:40	01:00	00:45	01:10	00:30	02:00	01:00	01:05	01:00	01:05	01:05	01:00	01:00	01:35	00:40
Start Time		16:20	08:35	10:00	15:15	15:50	08:30	08:15	08:30	17:15	17:00	09:45	17:30	10:15	08:50	17:00	08:45	15:50	10:00	16:15	13:30	09:30	09:30	10:30	15:50	10:30	14:30	14:25	08:45
End Time		16:45	09:05	10:30	16:15	16:50	09:30	09:15	09:15	18:15	18:00	10:45	18:30	11:15	09:30	18:00	09:30	17:00	10:30	18:15	14:30	10:35	10:30	11:35	16:55	11:30	15:30	16:00	09:25
Confirmed burrow Activity	E8A	0	0	0	0	0	2	2	2	0	0	0	0	0	2	0	1	0	0	1	2	0	2	0	0	0	0	0	1
	E8B	0	0	0	0	0	0	2	1N	0	0	0	0	0	1	0	0	0	2	0	0	0		0	0	0	0	0	0
	E8C	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2	0	0	0		0	0	0	0	0	0
	E8D	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	0	1	0	0	0		0	2	0	0	0	1
	E8E	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1F	2	0	0	0	2
	E8F	0	1	0	0	0	2	0	1	0	0	0	0	0	1	0	2	2	2	2	2	2	1	2	2C	0	0	0	1
	E8G	0	0	0	0	0	0			0	0	0	0	2	1	2	1	0	0	2	2	2	2	2	1	0	0	1	0
	E8H	0	0	0	0	0	3	2		0	0	0	0	0	1	0	1	1	0	2F	1F	2	2	1F	2	0	0	0	1
	E8I	0	0	0	0	0	1	2		0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	0	0	0	0	0
	E8J							2	2	0	0	0	0	0	1	0	0	0	0	0	2F	0		0	0	0	0	0	2
	E8K								2	0	0	0	0	1	0	0	2	0	0	2	2	0	2	0	0	0	0	0	2
	E8L								1	0	0	0	0	0	0	0	1	0	0	0	0	0		0	0	0	0	0	0
	E8M																							1F	1F	0	0	1	0

Key for Tables 4-7

1	Observation made, number of puffins	F	Feeding Observed	C	Chick Observed

Productivity estimate

St Philip's Stone F4

Despite activity in seven holes in 2009, only two breeding pairs were identified (at burrows $_{F4}$C & $_{F4}$E). This compares with five pairs at this site in 2008. The 2009 surveys showed no evidence of chicks being fed, therefore returning a productivity of 0.0 per pair.

Burrows $_{F4}$O & $_{F4}$M were excluded from the productivity dataset as birds were not observed at $_{F4}$M on after 22 April and though birds were present at $_{F4}$O from 22 April to 8 July, behavioural observations at this burrow suggested that no breeding attempt was made.

In 2010 three breeding pairs were identified using the guidelines set out in the methods section; specifically at burrows $_{F4}$C, $_{F4}$D & $_{F4}$E. Breeding success was confirmed at burrows $_{F4}$C & $_{F4}$E; adults were seen taking food into both burrows and a chick was sighted at burrow $_{F4}$C on 12 July 2010.

Table 8: Summary of Puffin productivity at St Philip's Stone, 2007-2010

	2007	**2008**	**2009**	**2010**
Breeding pairs	5	5	2	3
Confirmed	4	4	0	2
Productivity	0.8	0.8	0.0	0.67

Jenny's Cove E8

In 2009 four breeding pairs were identified at Jenny's Cove ($_{E8}$A, $_{E8}$B, $_{E8}$F & $_{E8}$G), all of which were observed entering burrows on at least two occasions before the end of May. Feeding was observed at burrows $_{E8}$B, $_{E8}$F & $_{E8}$G.

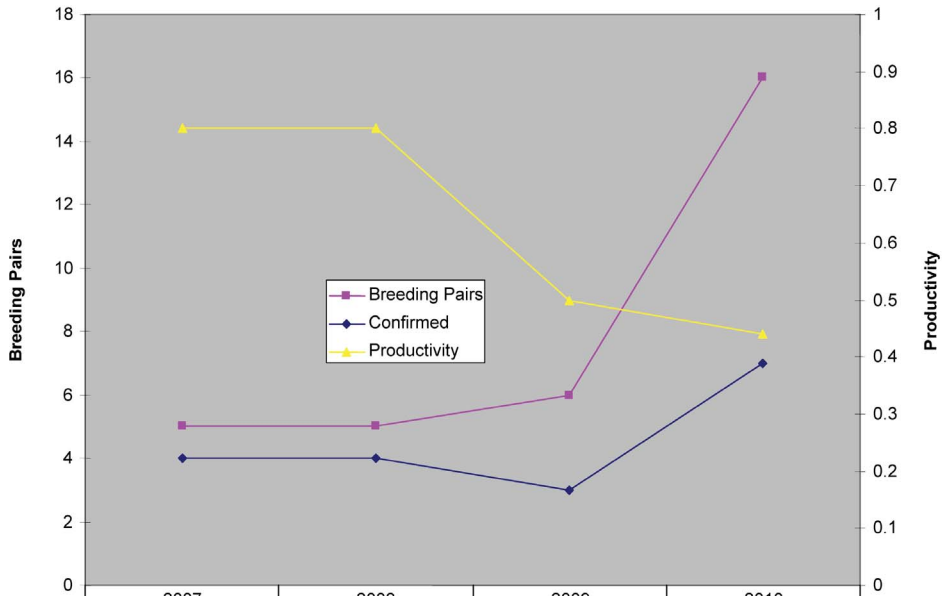
2010 showed a substantial increase to eleven breeding pairs ($_{E8}$A, $_{E8}$B, $_{E8}$C, $_{E8}$D, $_{E8}$F, $_{E8}$G, $_{E8}$H, $_{E}$I, $_{E8}$J, $_{E8}$K & $_{E8}$L) all of which were observed entering burrows on at least two occasions before the end of May. In addition, birds were found to have bred successfully in burrows $_{E8}$E & $_{E8}$M when feeding of young was observed later in the season, thus taking the total number of breeding pairs to 13.

Breeding was confirmed in four burrows, ($_{E8}$E, $_{E8}$H, $_{E8}$J, $_{E8}$M), through observation of feeding and a chick were seen at $_{E8}$F.

Table 9: Summary of Puffin productivity at Jenny's Cove, 2007-2010

	2007	**2008**	**2009**	**2010**
Breeding pairs	0	0	4	13
Confirmed	0	0	3	5
Productivity	0	0	0.75	0.38

Figure 3 summarises the number of breeding pairs and productivity on Lundy 2007-2010.



	2007	2008	2009	2010
Breeding Pairs	5	5	6	16
Confirmed	4	4	3	7
Productivity	0.8	0.8	0.5	0.44

Figure 3: Breeding Numbers and Productivity 2007-2010

DISCUSSION

When attempting to assess the Puffin population on Lundy it is worth noting that immature birds may be present well before June (Harris, pers. comm.). Data from the Isle of May show that some older immature birds may arrive as early as April, which illustrates that even assessing breeding numbers from counts made early in the season can be prone to over-estimation. Additionally, non-breeders are far more mobile and therefore birds observed away from known breeding sites may well not be of breeding age. Furthermore, small groups of such birds observed on the water at different locations on different days may involve the same individuals, which could again lead to an over-estimation of the numbers present. Counts made towards the end of the season, particularly in late June and July, whilst perhaps indicative of the potential for future breeding numbers, should not be considered a reliable measure of the size of the current breeding population.

In order to obtain representative population estimates, it is recommended that a minimum of two whole-island surveys are carried out by the wardens in early June, following the census methodologies, as this would allow more accurate comparisons and provide a continuous comparable dataset.

Recent observations have shown the presence of Puffins at other potential breeding sites around the island. These sites should be monitored in future years to determine whether they become established as successful colonies. An annual census in June would provide a good indication of Puffin distribution and identify further potential breeding sites.

In 2009, Puffins were observed occupying a burrow at Long Roost (G24). A pair was also seen in the same area on 30 May and though present for the rest of the season and occupying a burrow, there was no evidence of breeding. Interestingly, the burrow was situated in the same location as the historical records from previous site registers, 'on broken grassy ledges at the RHS' (Price, 2004). A maximum of five Puffins were seen at this location late in the season on 12 July, further supporting the possibility of future colonisation.

Table 10: Summary of Site Register Puffin sightings at Long Roost, 1992-2008 and 2010

1992	1996	2000	2004	2008		2010
4 + 1 on sea	13	5 on sea	–	–		2

Another encouraging record from 2010 was a count of 50 Puffins present simultaneously at various locations around much of Jenny's Cove on 25 June. The specific site register locations and numbers involved were E1-3, E3-2, E4-3, E8-33, E12-9 and E14-14.

A new site was identified in 2010 at the St Philip's Stone colony, on a slope between the viewing point (Fe) and the main colony (F4); the slope is unclassified in the Site Register but is between sites F4 and F5 and is partially obscured from view, with only the northern facing slope visible from Fe. A Puffin was recorded at this location on 1 May 2010 and subsequent sightings were made on 17 May, 24 May, 19 June and 25 June, with a maximum count of three birds on the latter date.

As noted earlier, estimating Puffin productivity presents difficulties when such small numbers are involved, particularly as estimates in this report have been calculated conservatively. In view of this, the following commentary qualifies some of the specific findings:

- The zero productivity figure returned for St Philip's Stone in 2009 may not be a fair reflection of breeding success at the colony. Puffin pairs at burrows $_{F4}$C & $_{F4}$E certainly showed behavioural patterns which indicated breeding, but proof could not be obtained. The fact that the number of surveys conducted during chick rearing was limited due to adverse weather may have contributed to this.
- In 2010, Puffins were observed in Jenny's Cove at burrow $_{E8}$E on 19 April, but were not seen again until 14 June. With only one observation recorded before the end of May, this burrow would not have been included in the productivity sample had taking of food into the burrow not been observed later in the season. Similarly, burrow $_{E8}$M was not identified until 27 June when a feed was observed.
- Burrow $_{E8}$E in Jenny's Cove has not been included in the breeding sample for 2009 as only one observation was recorded before the end of May. Despite this, burrow activity was recorded in all subsequent surveys, while on 10 July behaviour of adults suggested that a feed took place though this remained unconfirmed as no fish were seen.
- Based on sightings throughout the 2010 season, it is likely that the pairs at burrows $_{E8}$A and $_{E8}$G in Jenny's Cove bred successfully. However, without either a confirmed observation of either food being taken into the burrow or of chicks, we have not included these as successful pairs.

- Burrows $_{E8}$B and $_{E8}$C at Jenny's Cove were included in the dataset for 2010 as a result of early season activity, but the birds here may well have been immature, which would account for subsequent lack of recorded activity.

These points emphasise that with observational surveys of such a small population there is considerable margin for error. The productivity results for both 2009 and 2010 have been estimated with caution to ensure that they are not overly optimistic.

The surveys that took place in 2009 and 2010 were limited in number and duration due to time constraints, other work commitments and adverse weather. While the data obtained have provided valuable results, the productivity and overall breeding population could be assessed with greater accuracy if further surveys were to take place. With this in mind, and subject to the assistance of volunteers, the aim for 2011 will be to conduct more extensive surveys during the chick-rearing period. Not only will this enable us to confirm with more certainty the number of successful burrows, it should also provide us with useful data on the provision of food for chicks.

CONCLUSIONS

While some aspects of the survey work and the results may be subject to speculation and interpretation, 2010 was the fourth consecutive year in which surveys have taken place using the same methodologies, allowing comparisons to be made between years with a reasonable degree of confidence. Figures 1, 2 and 3 all show a marked increase in the numbers of both breeding pairs and total birds present and - based upon the number of late-season prospecting birds present - this trend may be expected to continue.

Lundy's breeding Puffin population in 2010 was an estimated 16 pairs, representing a 260% increase since the first surveys of this kind in 2008. Counts and general observations over the past five years have shown an increase in the number of birds present around the island, with numbers that would have been unprecedented in the late 1990s and early 2000s before the eradication of rats.

This influx of Puffins is undoubtedly the result of immature birds from other colonies prospecting for future nesting burrows. Since rat eradication in 2004, only a small number of Puffins will have fledged from Lundy, certainly not enough to account for the increase in the numbers witnessed in late June 2010. It is assumed that the increase in breeding adults at Jenny's Cove has attracted younger birds ashore to assess the site as a potential breeding colony.

The re-colonisation of Jenny's Cove in the last three years is particularly significant, the colony having expanded by 325% in just one year, from four breeding pairs in 2009 to 13 pairs in 2010. It is hoped that this consolidation will continue, with the site attracting more young adults and becoming a well-established breeding colony. Other sites, including St Philip's Stone and Long Roost, could follow the recent trend observed at Jenny's Cove.

If, as appears to have happened in Jenny's Cove, birds return to historically favoured sites, future re-colonisation of sites north of St John's Stone (specifically G16 & G18) and on the west coast from Battery Point (D3) to south of Needle Rock (D7) could be expected. Indeed there were unconfirmed sightings of Puffins seen on land on the south side of Dead Cow Point (D3) in 2007 and 2008 and regular sightings of Puffins on the water north of Dead Cow Point below the Forgotten Heinkel in every year since 2007.

Obtaining representative productivity estimates continues to pose the greatest difficulty and while productivity rates appear to have declined, this may be due to an over-estimation of the number of breeding pairs. However, if the 2010 value is a true figure, it may indicate that Lundy had a high proportion of first-time breeding pairs in 2010 and their inexperience may have resulted in higher failure rates. Despite this apparent decline in productivity, at least seven Puffin pairs successfully reared chicks in 2010, a 75% increase since 2007 and 2008.

Overall, the results are extremely positive and show an increasing trend in both the number of Puffins present around the island and the actual breeding population. While productivity may be difficult to determine accurately, chicks are certainly being raised successfully each year. Undoubtedly the rat eradication has had a significant and positive impact on the suitability of Lundy as a breeding colony for this iconic and charismatic species.

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