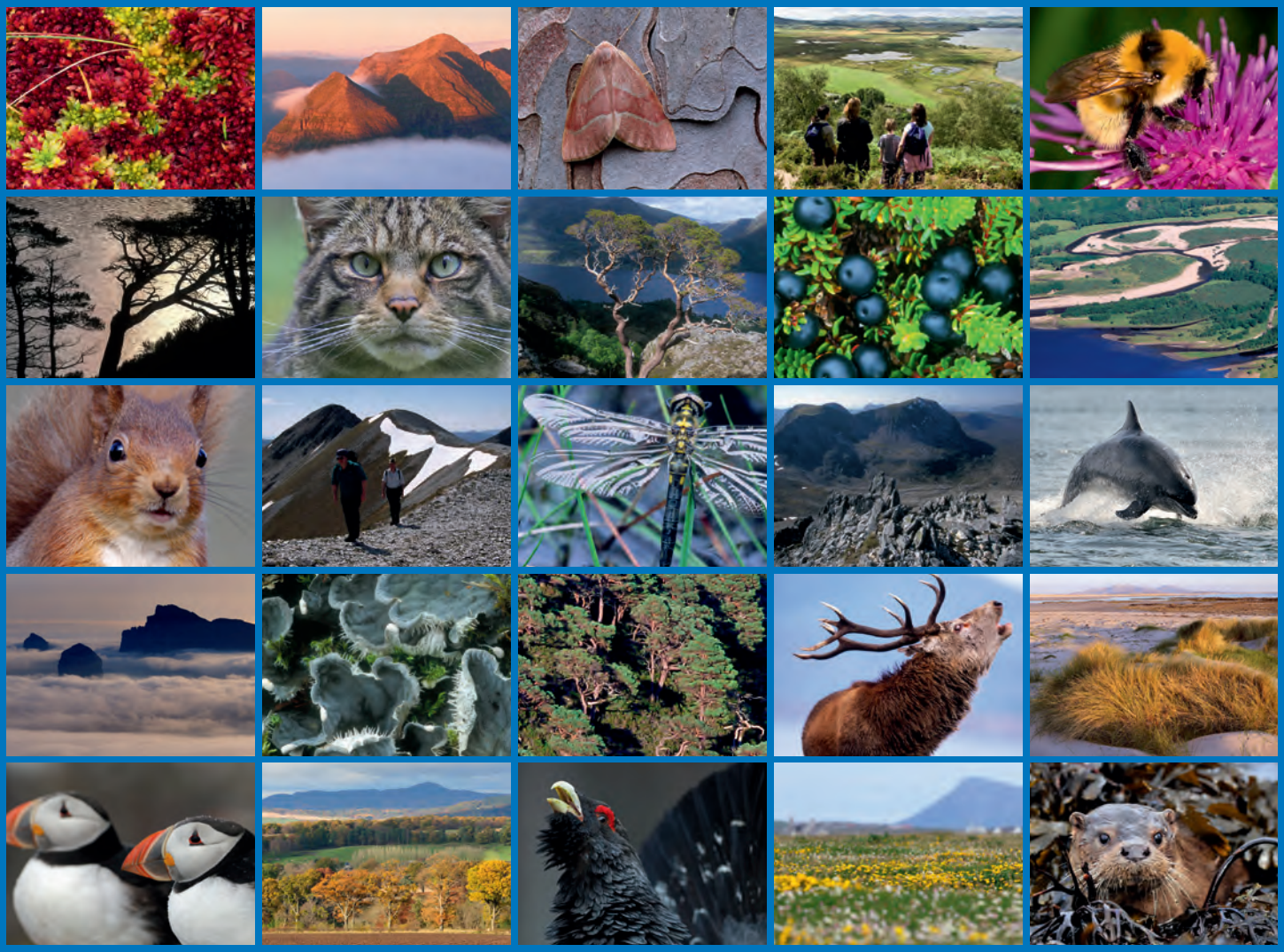
Scottish Natural Heritage
Commissioned Report No. 703

Breeding success of cliff nesting seabirds in Mainland Orkney in 2013 and initial review of Orkney seabird monitoring



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COMMISSIONED REPORT

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Breeding success of cliff nesting seabirds in Mainland Orkney in 2013 and initial review of Orkney seabird monitoring

For further information on this report please contact:

Alex Robbins
Scottish Natural Heritage
Battleby
Redgorton
PERTH
PH1 3EW
Telephone: 01738 458653
E-mail: alex.robbins@snh.gov.uk

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COMMISSIONED REPORT

Summary

Breeding success of cliff nesting seabirds in Mainland Orkney in 2013 and initial review of Orkney seabird monitoring

Commissioned Report No. 703
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Keywords

Seabirds; Orkney; plot monitoring; breeding productivity.

Background

Populations of selected cliff-nesting seabirds at colonies in Mainland Orkney have been monitored by JNCC (formerly NCC) since 1976. Breeding success was also monitored for over 30 years, until 2009. This research has been commissioned by SNH in partnership with RSPB to:

- provide continued monitoring of breeding success of cliff-nesting seabirds at a number of colonies near and/or adjacent to proposed marine renewable developments in Orkney;
- summarise population trends of cliff-nesting seabirds in Orkney; and,
- inform a future review of seabird monitoring in Orkney with particular focus on supporting bids for longer-term funding sources in light of a need to understand the impacts of the growing marine renewables industry.

Main findings

- Fulmars were monitored in 12 sample plots at Costa Head, Mull Head and Gultak, where respective productivity figures were 0.53, 0.30 and 0.37 young fledged/AOS. Overall mean productivity was 0.40 (± 0.07).
- European shags were monitored in 2 sample plots at Mull Head. Mean productivity was 1.93 (± 0.40) young fledged/AON.
- Black-legged kittiwakes were monitored at Row Head, Marwick Head, Costa Head and Gultak. Complete breeding failure was observed in all 15 sample plots except New Plot 03 at Gultak, which fledged one chick (productivity 0.20). Mean productivity was 0.04 (± 0.04) young fledged/AON.
- Guillemots were monitored in single sample plots at Marwick Head and Mull Head, where respective productivity figures were 0.10 and 0.14 fledged per active and regular site. Overall mean productivity was 0.12 ± 0.01 fledged per active and regular site.
- Guillemot chick diet and provisioning monitoring was carried out at Marwick Head and Mull Head. Out of 44 feeding events, 64% of feeds were sandeel and 18% clupeid. Provisioning rate was calculated to be 0.27 feeds/chick/hour.

- Razorbills were monitored in single sample plots at Marwick Head and Mull Head, where respective productivity figures were 0.43 and 0.35 young fledged per active and regular site. Overall mean productivity was 0.39 (± 0.04).
- Summaries are presented of population trends for fulmars, black-legged kittiwakes, guillemots and razorbills in Orkney, derived from JNCC data. Of particular note is a decline of over 80% in kittiwake numbers since 1986
- Recommendations are made for amendments to the breeding success monitoring programme for cliff-nesting seabirds in Mainland Orkney, including extensions and additions to sample plots and inclusion of European shags and razorbills (section 9).

For further information on this project contact:
Alex Robbins, Scottish Natural Heritage, Battleby, Redgorton, Perth, PH1 3EW.
Tel: 01738 458653 or alex.robbins@snh.gov.uk
For further information on the SNH Research & Technical Support Programme contact:
Knowledge & Information Unit, Scottish Natural Heritage, Great Glen House, Inverness, IV3 8NW.
Tel: 01463 725000 or research@snh.gov.uk

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1. INTRODUCTION

1.1 History of the Seabird Monitoring Programme in Orkney

Breeding populations of cliff-nesting seabirds in Orkney are among the largest in Britain. Table 1 summarises breeding numbers for five target species from Seabird 2000, when the last major seabird census took place, and indicates their national and international importance. In 1976, concern about vulnerability of four of these nationally important breeding seabird populations (excluding European shag) and their sensitivity to environmental change and oil spills, prompted the Nature Conservancy Council, now Joint Nature Conservation Committee (JNCC), to initiate a monitoring programme. This work began with collecting baseline population data, and setting up population monitoring plots within the five key Mainland colonies. These plots have been monitored yearly from 1976 – 1988 and then triennially up to and including 2012.

Table 1. Results from Seabird 2000 in Orkney, data from Mitchell et al., 2004

Species (unit)	Orkney total	Britain and Ireland total (Orkney %)	Biogeographic region of range (subspecies)	Total in range (Orkney %)
Northern fulmar *Fulmarus glacialis* (AOS)	90,846	537,991 (17%)	Atlantic *(glacialis)*	2,700,000 – 4,100,000 (2.2 – 3.4%)
Black-legged kittiwake *Rissa tridactyla* (AON)	57,668	415,995 (14%)	North Atlantic *(tridactyla)*	2,500,000 – 3,000,000 (1.9 – 2.3%)
Common guillemot *Uria aalge* (individual)	181,026	1,559,484 (12%)	North Atlantic *(aalge* and *albionis)*	2,800,000 – 2,900,000 (6.2 – 6.5%)
Razorbill *Alca torda* (individual)	10,194	216,087 (4.7%)	NW Europe *(islandica)*	530,000 (2%)
European shag *Phalacrocorax aristotelis* (AON)	1,872	32,306 (6%)	NE Atlantic *(aristotelis)*	66,000 – 73,000 (2.6 – 2.8%)

Population trend data can show long-term effects of environmental change while annual productivity data can provide a more sensitive and reactive indicator of the effects of environmental change, such as food shortages, to inform understanding of the drivers of observed population trends.

Hence, productivity monitoring methods were also developed and productivity has been monitored annually in plots from 1983 (common guillemots), 1984 (black-legged kittiwakes) and 1989 (northern fulmars) until 2009 when funding ceased. Volunteers for the RSPB continued the work partially in 2011 and fully in 2012.

In light of the many environmental pressures that face seabirds in Orkney at this time, and the current negative trends both in populations and productivity, continuation of this monitoring is more valuable than ever. Orkney is experiencing a large increase in renewable industry development, and many of the seabird colonies around Orkney Mainland are now near and/or adjacent to proposed marine renewable development sites. This work provides an up to date baseline, which allows us to monitor potential impacts from these developments at a colony level. The results of this project can help inform marine renewable

casework in Orkney waters, and will feed into Site Condition Monitoring and the UK Seabird Monitoring Programme (JNCC, 2013b).

1.2 Objectives of the 2013 work

This work was undertaken in order to maximise our ability to understand possible impacts of the growing renewable industry and environmental change upon the declining breeding seabirds in Orkney and to support bids for longer-term funding. It will provide data to support monitoring of any impacts of the industry on six seabird colonies. Specific objectives were:

1. To monitor breeding success of black-legged kittiwakes, northern fulmars and common guillemots at colonies on Mainland Orkney, including plots monitored at five colonies since the 1980s.
2. To identify where the current monitoring programme could be improved, extended or refined, especially for kittiwakes, and implement new monitoring, in order to increase understanding of the drivers of seabird breeding population changes.
3. To collect data on prey delivered to guillemot chicks, with a view to indirectly monitoring food availability in Orkney waters.

2. METHODS

2.1 Areas, plot selection and methods

2.1.1 Areas

Seabird populations at five seabird colonies on Orkney Mainland have been monitored since 1976: Costa Head, Row Head and Marwick Head in West Mainland; Gultak and Mull Head in East Mainland. In the 1980s monitoring plots for breeding success were set up in these colonies. Kittiwakes were monitored at Costa Head, Row Head, Marwick Head and Gultak, common guillemots at Marwick Head and Mull Head, and fulmars at Costa Head, Gultak and Mull Head.

In 2013, in addition to these sites, one new kittiwake colony, at the Brough of Birsay was monitored. In addition, European shags were monitored at Mull Head and razorbills were monitored at Mull Head and Marwick Head.

2.1.2 Plot selection

The original breeding success monitoring plots were selected as follows: photographs were taken in early May of suitable sections of colonies. Plots were selected non-randomly, and where sufficient choice was available, plots were spaced out through the colonies. This was to allow for variations within colonies (Ribbands, 1990). These breeding success monitoring plots have remained unchanged since 1989.

2.1.3 Expansion and changes to the seabird monitoring programme in Orkney

We trialled three key changes to the seabird monitoring programme in Orkney. First, to increase the number of species monitored and cover different breeding and feeding ecologies, productivity monitoring was expanded to include shags and razorbills. Secondly, extensions were made to the existing kittiwake monitoring programme, in order to increase coverage of kittiwake monitoring and to ease statistical issues with small sample sizes. Finally, to monitor food availability, we trialled data collection on the feeding frequency of guillemot and razorbill chicks. These changes are outlined in more detail below.

2.1.3.1 European shag

Shags forage locally and are therefore sensitive to local conditions, and they rely heavily on sandeels (JNCC, 2013a). Two plots were selected at Mull Head due to their ease of monitoring and numbers of nests present (during the search time, in mid-June). The first plot, called Facing Brough, contained 19 Apparently Occupied Nests (AON). The second plot is located at Twisting Nevi and contained 9 AON. There is already a large fulmar plot here, and the shag plot overlaps with a suitable razorbill plot (see section 2.2.4).

2.1.3.2 Black-legged kittiwakes

The extensions to kittiwake plots are summarised in table 2 (refer to Annex 7 for plot extension photos). Three plots (two at Marwick Head and one at Costa Head) were identified that had fewer than the preferred minimum of 50 AON (Walsh *et al.*, 1995) and that could be easily extended to include a substantial increase in AON. In addition, two extra plots were identified at Marwick Head (North End) that could be easily monitored in conjunction with existing monitoring. Two plots in a colony at the Brough of Birsay, that were located and selected by Roddy Mavor (JNCC) in 2012 and partly monitored in that year, were also monitored in 2013.

It should be noted that these new plots and plot extensions were not chosen randomly, because the number of breeding kittiwakes in Orkney has reduced to an extent that it is

difficult to find new areas that hold substantial numbers. Also, the extensions and new plots are in the centre of the colonies and are therefore more likely to include the most effective breeders.

Table 2. Extensions and plot additions for black-legged kittiwakes, and their outcomes

Location	Action	Outcome
Costa Head, West Mainland	Plot expansion 'Above Cave'	Added 7 AON and 6 trace, total 21 AON. Angle is okay, nest contents visible
Marwick Head, West Mainland	Plot expansion 'Monument Lower'	Added 15 AON, total 26 AON.
Marwick Head, West Mainland	Plot expansion 'North End'	Added 16 AON and 6 trace, total 58 AON.
Marwick Head, West Mainland	Plot additions 'North End Mid' and 'Lower'	Added 30 AON each. Had to move slightly to see lower plot.
Brough of Birsay, West Mainland (tidal)	New colony on Brough of Birsay	Added 85 AON across 2 plots. Timings with tidal causeway fine.

2.1.3.3 Common guillemot

We trialled data collection on the frequency with which guillemot chicks are fed, and size and species of prey fed to chicks (see section 2.1.4.4 for methodology).

2.1.3.4 Razorbill

The monitoring of razorbill breeding success was trialled during 2013, in addition to feeding frequency. Razorbills feed on sandeels yet differ in their foraging methods to guillemots, as they can carry more than one prey item at a time. Two plots were selected: Peedie Geo at Marwick Head, containing 23 pairs and Twisting Nevi at Mull Head containing 17 pairs. These plots were selected due to ease of monitoring and numbers present within the plots in June. Peedie Geo overlaps with the guillemot monitoring plot, and Twisting Nevi is in walking distance from the Main Cliff guillemot plot, and overlaps with the shag plot (section 2.2.1). Therefore, they fit in well with current monitoring and without additional mileage.

2.1.4 Breeding success monitoring methods

All surveys were conducted according to the Seabird Monitoring Handbook for Britain and Ireland (Walsh *et al*., 1995). Productivity monitoring method 1 was used unless otherwise stated. Full plot-by-plot details should always be reported, as this level of detail is required for JNCC analyses (Mavor, R., *pers. comm.*). Visit duration and transit time to colonies are outlined in table 19 (Annex 6) for each plot and species.

2.1.4.1 Northern fulmar

Fulmars were monitored in 11 plots at 3 colonies (see section 2.1.1). Monitoring commenced on 29th May. Six visits were made until 30th August. Three visits were made 3-4 days apart in late May – early June to identify Apparently Occupied Sites (AOS), here defined as a bird apparently incubating on all three visits. Each numbered site was checked again in early August for young, and two further visits were made to plots to follow small young around 2-3 weeks apart. All large young or young seen on the last visit that were downy and about adult-size were assumed to have fledged successfully. For each plot, results are expressed

as mean number of young fledged per regularly occupied site (AOS). Colony productivity is expressed as mean of the plot figures (±SE).

2.1.4.2 European shag

European shags were monitored in 2 plots at Mull Head in north-east Mainland. The plots were identified in June (see section 2.1.3.1) and monitoring commenced on 24th June. Note that UK standard methodology states monitoring should begin in mid-April. The plots were visited weekly until 5th September, totalling 12 visits. Chicks were assumed to fledge successfully when they appeared well-feathered with little or no down on upper wings or mantle. Results are expressed as: the total numbers of nests where eggs or apparent incubation were recorded, but failed or fledged one, two, or three chicks; and, the total number of young fledged divided by the number of nests where birds were definitely or probably incubating. Results are not pooled across plots; instead the mean productivity for the colony is calculated as the mean of the individual plot figures (±SE) (Walsh *et al.,* 1995).

2.1.4.3 Black-legged kittiwake

Kittiwakes were monitored in 14 plots at six colonies (2.1.3.2). The first visit should occur in late May and a second in mid-June. Following that, another visit should be made when chicks are close to fledging age (30 days) to age young. Small young broods should be checked on as necessary.

Monitoring took place from 25th May to 14th August, although the first visit to the Brough was in early June and the new plots at Marwick (North End mid and lower) were first visited in mid-June and late June, skipping the visit in May. Due to the lateness of the season, an extra visit was required in the first week of June to map nests accurately at all other plots. The season was atypical and another 2-6 visits were made to plots (depending on breeding progress) during July and August. As well as monitoring AON, trace nests were counted. Chicks were assumed to fledge when they disappeared at 35 days or older, or when wing-tips exceeded tail length (Walsh *et al.,* 1995). For each plot, results are expressed as mean number of young fledged per complete nest (AON). Colony productivity is expressed as mean of the individual plot figures (±SE) (Walsh *et al.,* 1995).

2.1.4.4 Common guillemot

Guillemots were monitored at Mull Head and Marwick Head. Monitoring took place from 25th May to 28th July, totalling 24-31 visits per colony. Four initial visits were in late May and early June made to map all occupied sites. Any bridled birds in pairs were noted for ease of identification. Pairs that were in attendance for two in any three consecutive visits at sites that were capable of supporting an egg were classed as regular pairs and also mapped. From 14th June, the plots were visited every day or every other day (with an exceptional 3-day interval). New sites were added as necessary. When calculating productivity, chicks that reached 15 days old before they disappeared were deemed as successfully fledged. If the hatch date was unknown, chicks were aged using the guide to guillemot chick ageing in the Seabird Monitoring Handbook (Walsh *et al.,* 1995). For each plot, results are expressed as number of young 'fledged' per active site, and per active and regular site. Colony productivity is expressed as the mean of plot figures (±SE) (Walsh *et al.,* 1995).

Data on guillemot diet and feeding rate were collected at both sites with reference to "Instructions for collecting data on guillemot diet and provisioning rate", (Wanless, n.d.). Observations were made throughout the chick-rearing period (as far as possible) between 0755 – 1155 (guidelines state 0600 – 1000 hours) and lasted between 1 – 2 hours (guidelines state 2 hours). The instructions recommend watching a group of guillemots once there are ~10 chicks present; however, due to the poor quality of the season it was only possible to achieve this on one visit and most were made with fewer chicks than this. It is

also recommended that the diet monitoring be carried out twice weekly; however this was undertaken at lesser frequency around the other seabird monitoring. The key pieces of information recorded on every visit were: start and end time, location, how many chicks were watched, how many feeds were delivered, at which site the chick was fed, size and species of every prey delivered if known, size and species of display fish carried by adults and weather conditions (if they were adverse).

2.1.4.5 Razorbill

Razorbills were monitored at Mull Head (Twisting Nevi) and Marwick Head (Peedie Geo). The plots were identified in mid-June (see section 2.1.3.4). Monitoring took place from 19th June to 2nd August, totalling 14-18 visits per colony. All occupied sites were noted from the first visit. Pairs that were in attendance for two in any three consecutive visits at sites that were capable of supporting an egg were classed as regular pairs and also mapped. From 25th June, the plots were visited every 1-4 days. Note that standard UK methodology states plots should be visited every day or other day (see recommendations section). New sites were added as necessary. When calculating productivity, chicks that reached 15 days old before they disappeared were deemed as successfully fledged. If a rough hatch date was unknown, chicks were aged as soon as possible. For each plot, results are expressed as number of young 'fledged' per active site, and per active and regular site. Colony productivity is expressed as the mean of plot figures (±SE) (Walsh *et al.,* 1995). Any chick feeding events observed while monitoring breeding success were recorded: pair, prey species, size or amount, time.

3. NORTHERN FULMAR *FULMARUS GLACIALIS*

3.1 Breeding productivity

Fieldwork was carried out between 29th May and 30th August. Six visits were made to the colonies.

3.1.1 Results 2013

The results are summarised in Table 3. For more detailed results, see annex 1.

Table 3. Breeding success of northern fulmars in Orkney in 2013. Fledged implies large young or adult-sized downy young (Walsh et al., 1995). Young fledged per AOS is the summed mean, mean productivity is mean of plots.

Colony	AOS	Fledge	Young fledged/ AOS	Mean productivity ± S.E.
Costa Head	131	68	0.52	0.53 ± 0.06
Gultak	119	47	0.39	0.37 ± 0.06
Mull Head	153	47	0.31	0.30 ± 0.04
TOTAL	**403**	**162**	**0.40**	**0.40 ± 0.07**

There was a slight increase in number of AOS of 12% from 2012 to 2013 in these plots. The overall mean productivity was 0.40: similar to 2012 when mean productivity was 0.41(± 0.07) (Table 3). This compares favourably with the national average during 1986-2008, which was 0.39 (JNCC, 2013a; see section 2.2.6). However, there was a lot of variation in breeding success between colonies and even between plots. In previous seasons, this has been linked to different predation pressures at various sites. In 2013, a few predated eggs were seen in the Gultak colony in early June, and there were several known early fails. Here, jackdaws and gull species were seen frequently. A great black-backed gull was seen predating what looked like a fulmar chick at Mull Head, while at Costa Head, ravens, jackdaws and great black-backed gulls were seen frequently. No mammalian predators were seen around the colonies. It is worth noting that at the end of the season, very bad weather coincided with a large number of fulmar fledglings leaving the cliffs, and between 50-100 fledglings were seen grounded around Orkney. This is a higher number than found in other years. This may have reduced the number of birds that successfully fledged this season.

3.1.2 Breeding productivity 1989 – 2013

Fulmar breeding success between 1989 and 2013 is summarised in figure 1. In 1989, the methods were slightly different and initial checks were made slightly later, therefore the result in this year is not directly comparable. In 2000, a single count of AOS was carried out in mid-late June.

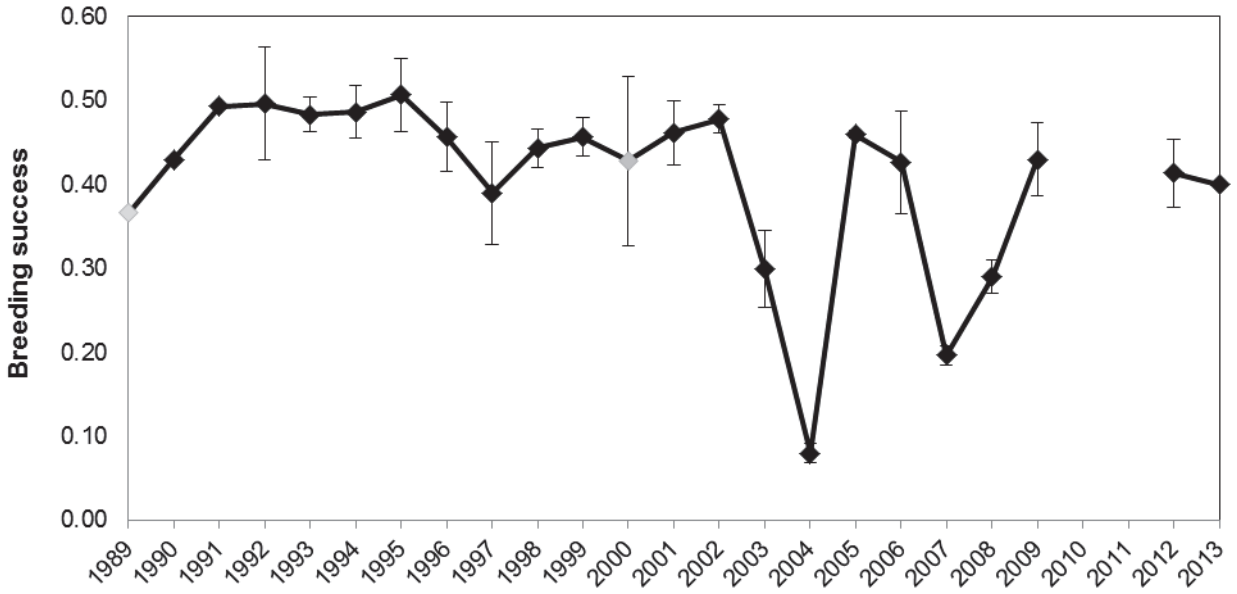

Figure 1. Northern fulmar breeding success (mean chicks fledged per AOS), 1989 – 2013. Error bars are one standard error. Greyed points indicate caveat, see section 3.1.2

Fulmar mean breeding productivity in Orkney ranged between 0.39-0.51 between 1990 and 2002, which is on or above the national average (0.39 between 1986 and 2008, JNCC, 2013a). Historically, there has been a lot of variation between colonies, with Costa Head being the most successful colony on average. In 2003 and 2004, there were two unprecedentedly sharp decreases in breeding success to. 0.30 in 2003 and 0.08 in 2004 – the lowest productivity recorded since monitoring began in 1989. This coincided with the least productive seabird breeding season nationally on record, which was linked to severe food shortages (Mavor *et al.*, 2004). In 2007 and 2008, productivity was again very low at 0.20 and 0.29 respectively. This pattern was observed across UK colonies, and also in both kittiwakes and guillemots. Following this, mean fulmar productivity in Orkney in the three years when it has been monitored (2009, 2012 and 2013) increased again to the same level recorded in the previous years. This was not observed in guillemots and kittiwakes and could suggest that the breeding success of fulmars at these colonies has been more consistent than other cliff-nesting species.

3.2 Breeding numbers

Fulmar population monitoring has been carried out across Orkney since 1986 by JNCC. The results are summarised up to 2012 in Fig. 2 (Mavor, 2012).

There was a steady increase in population from 1986 to 2000. Since 2000, there has been a significant negative rate of change, -4.6% per annum, across all colonies. In 2012, the population index level was at 76% of the 1986 baseline (Mavor, 2012). However, as with breeding productivity, there is considerable variation between colonies and at Gultak and Mull Head fulmar numbers are at approximately the same level as 1986.

Older monitoring studies show that overall there was an increase in the population in 1976 – 1982 followed by a contraction. In 1985 the population index was at 107% of the 1976 level, indicating a slight overall increase during this period. However, at Row Head and Marwick Head the indices were equal to (Row) or lower than (Marwick) the 1976 baseline population level (Benn & Tasker, 1986).

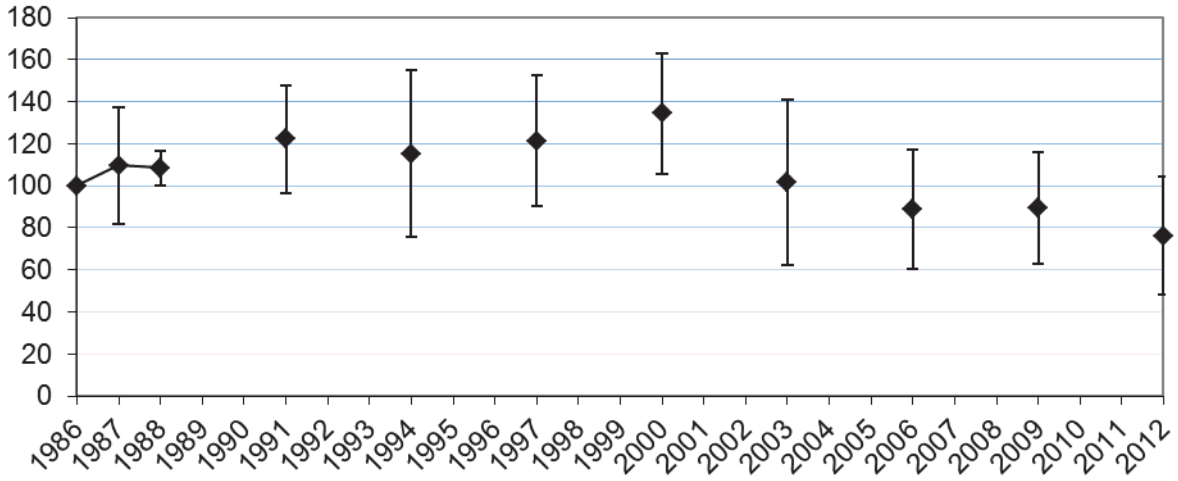

Figure 2: Population index for individual fulmars at monitoring plots across all colonies in Orkney from 1986 – 2012 with 95% CLs. Counts were annual in 1986-1988 and then triennial. Graph reproduced from Mavor, 2012.

4. EUROPEAN SHAGS *PHALACROCORAX ARISTOTELIS*

4.1 Breeding productivity

European shags were monitored in two plots at Mull Head from 24th June to 5th September 2013. The results are summarised in Table 4.

Table 4. Breeding success of European shags at Mull Head in 2013. AON implies nests where birds were definitely or probably incubating (Walsh et al*., 1995).*

Plot	AON	Failed nests	Fledged 1 chick	Fledged 2 chicks	Fledged 3 chicks	Total no. chicks fledged	Mean productivity ± S.E.
Facing brough	19	2	7	8	2	29	1.53
Twisting Nevi	9	0	2	2	5	21	2.33
TOTAL	**28**	**2**	**9**	**10**	**7**	**50**	**1.93 ± 0.40**

The mean breeding productivity was 1.93 young fledged/AON. This is 60% higher than the UK mean productivity of 1.21 during 1986 – 2008 (JNCC, 2013a). However, it is likely that some pairs failed early on and were missed because monitoring began later than standard (mid-April) as the plots were added a little late in the season. Only two nests failed during monitoring, in Facing Brough. Considering that monitoring started late and pairs may have attempted to breed unsuccessfully then left the cliffs, the productivity figure this year is probably an overestimate. However, few abandoned nests were visible inside the plots and no predation events were observed in or around the plots.

Monitoring carried out by the RSPB on Papa Westray, Copinsay and Muckle Skerry indicates that productivity is quite variable across Orkney. On Papa Westray, shags are monitored by RSPB in North Hill reserve. In 2013, 9 AON fledged 13 chicks (1.44 fledged/AON). On Copinsay and Muckle Skerry, productivity was calculated using JNCC method 2, which tends to over-estimate productivity (Walsh *et al.*, 1995). On Muckle Skerry, 2 chicks fledged from 10 AON (productivity 0.20) and on Copinsay, 12 chicks fledged from 9 AON (productivity 1.33 young fledged/AON). Therefore it might be valuable to monitor an additional shag colony in the future (see section 9.3).

5. BLACK-LEGGED KITTIWAKE *RISSA TRIDACTYLA*

5.1 Breeding productivity

Fieldwork began in May and the first monitoring visit was on 25th May. An extra visit in early June was carried out to account for the late season. Monitoring finished on 14th August and 4-8 visits were made to the plots.

5.1.1 Results 2013

The results are summarised in Table 5. For a more detailed summary, see Annex 1.

Table 5. Kittiwake breeding success in Orkney in 2013. Italics represent the totals without the new plots Brough, North End mid or lower, or any plot extensions at Marwick Head or Costa Head. Fledged means judged or known to have reached 35 days of age

Colony	AON	Trace	Large young (fledged)	Young fledged/AON	Mean Productivity ± SE
Costa Head	55	22	0	0	0
Brough of Birsay	85	16	0	0	0
Marwick Head	172	26	0	0	0
Gultak	5	0	1	0.2	0.2
Row Head	8	3	0	0	0
Total (no extensions)	*142*	*37*	*1*	*0.007*	*0.05 ± 0.05*
TOTAL	**325**	**67**	**1**	**0.003**	**0.04 ± 0.04**

There was a high proportion of trace nests in the total number of nests (17%). In 2012, 206 AON were found in the original plots. In 2013, the number was 142, a 31% reduction. Extensions and new plots increased the number of AON monitored by 183 up to 325. At Row Head, only 2 plots (Yettna new and Blossom) remain active and only 8 pairs nested. Due to the small number nesting here, these plots were combined in calculations. At Gultak, only one plot remains active (New Plot 03) and only 5 nested here.

Overall, productivity was extremely low with only one chick fledging, at Gultak. However, given the small number of nests within the plot (5 AON), productivity was 0.2, despite only one bird fledging; this does not accurately reflect the situation at Gultak. Total young fledged was 0.003/AON and mean productivity of all colonies was 0.04 (± 0.04). Fig. 3 illustrates the kittiwake nest outcomes at all colonies. The first clutch was observed at Peedie Geo on 30th May with two eggs, but these had already been abandoned. Nest building and laying went through until the end of June and by the end of the month, 47% of nests were empty or abandoned before eggs were observed. A further 41% of AON failed after eggs were recorded or adults were seen incubating. The first chick was seen at Peedie Geo on 2nd July. Across all the plots, only 25 nests were recorded with chicks but given difficulty detecting small chicks and spacing between visits this is likely to be an underestimate (see recommendations). The 2013 season was an even poorer season for kittiwakes than 2012, when mean productivity was 0.16 (± 0.09). These figures exclude Mull Head, where kittiwakes ceased breeding sometime between 2009 and 2012.

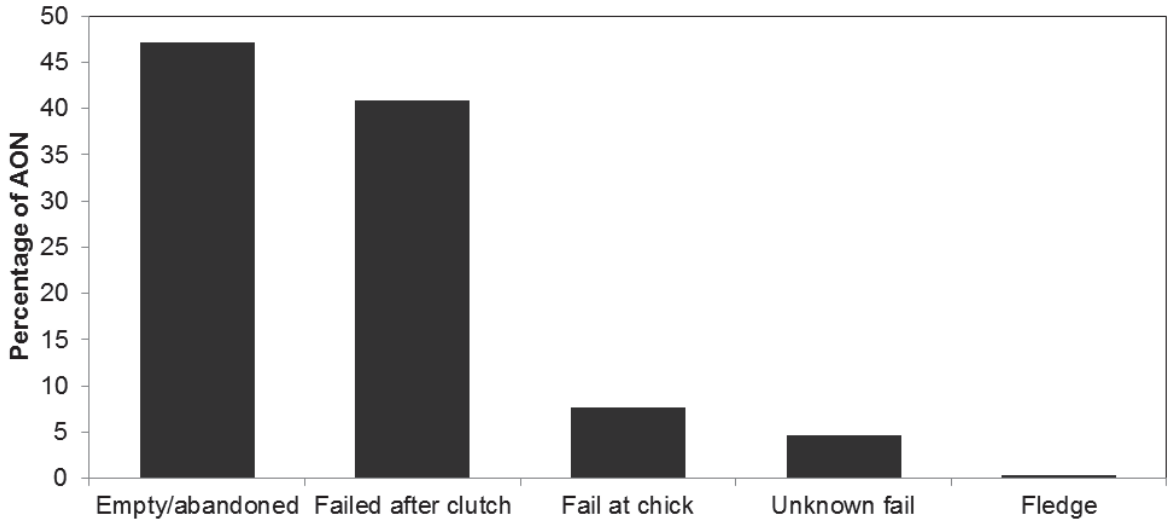

Figure 3. Kittiwake AON outcomes in 2013. "Empty/abandoned" when an adult was standing at an empty nest or a complete nest was recorded without an adult before eggs were recorded at that nest site. "Failed after clutch" when a nest failed after eggs were recorded or the adult was apparently incubating.

The effect of predation was difficult to gauge given how few nests had eggs and subsequently chicks. Disturbance by foraging great skuas was common at Marwick Head, and an egg and an adult kittiwake were predated at Peedie Geo. Great black-backed and herring gulls were frequently present around Marwick Head (especially Peedie Geo) and Row Head. At the Brough of Birsay, ravens and both gull species were present around the plots and a pair of adult kittiwake wings were found at the top of the cliffs in June.

5.1.2 Breeding productivity 1989 - 2013

Breeding productivity has been recorded in Orkney since 1989, and the results are summarised in Fig. 4.

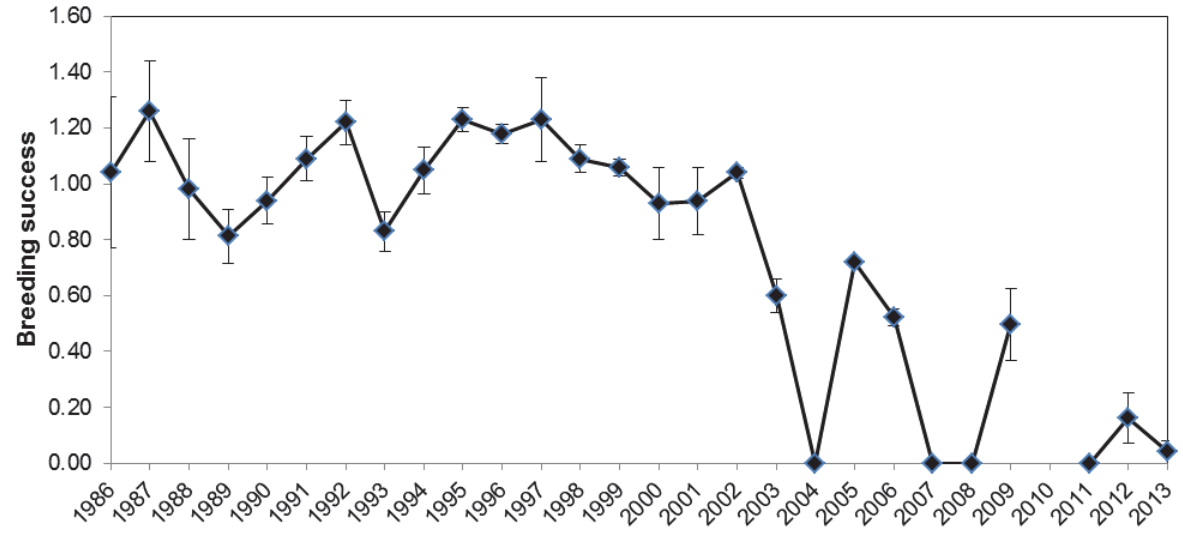

Figure 4. Black-legged kittiwake breeding success 1986 – 2013 with one standard error. In 1986-1988, Marwick Head only. Monitoring at Costa Head did not take place in 1990 or 1992 – 1997. In 2010, no monitoring took place and in 2011, only Marwick Head was monitored. Data from 2013 includes the Brough.

Between 1986 and 1988, breeding success of kittiwakes was estimated using a method that tends to over-estimate breeding success (Thompson & Walsh, 2000). In figure 4, these data have not been used; instead the figures shown are mapped nest and intensive monitoring data collected in two plots at Marwick, which was deemed more accurate (see section 9.8.1 and annex 3). From 1986 to 2002, kittiwake breeding success in Orkney was relatively stable: mean productivity was 0.93 – 1.23 chicks per AON, with the exception of 1989 and 1993 in which mean productivity was lower than average (0.81 and 0.83 respectively). In 1993, there was adverse weather early on in the chick-rearing period (Paice, 1993). Generally, smaller colonies performed slightly worse than larger colonies (Thompson & Walsh, 2000).

Since 2002, productivity has been low and variable. In 2003, it decreased dramatically and in 2004, there was complete breeding failure. This coincided with the least productive seabird breeding season nationally on record, which was linked to severe food shortages (Mavor *et al.,* 2004). In 2005-2006, productivity recovered slightly but there was total breeding failure again in 2007 and 2008. Food shortages, particularly of the main prey sandeel (*Ammodytes spp.*), were thought to be the cause. Also during 2004 – 2008 there was a large increase in snake pipefish around Orkney waters, which is a much less nutritious alternative to sandeels (Side, J., *pers. comm*). In 2009, mean productivity rose to 0.50, however, from 2011 to 2013 productivity has been extremely low, or zero. The pattern seen in 2002 – 2013 is similar to that of the common guillemots and to a lesser extent, northern fulmars, across Orkney.

5.2 Breeding numbers

Kittiwake population monitoring has been carried out across Orkney since 1986 by JNCC. The results are summarised up to 2012 in figure 5 (Mavor, 2012).

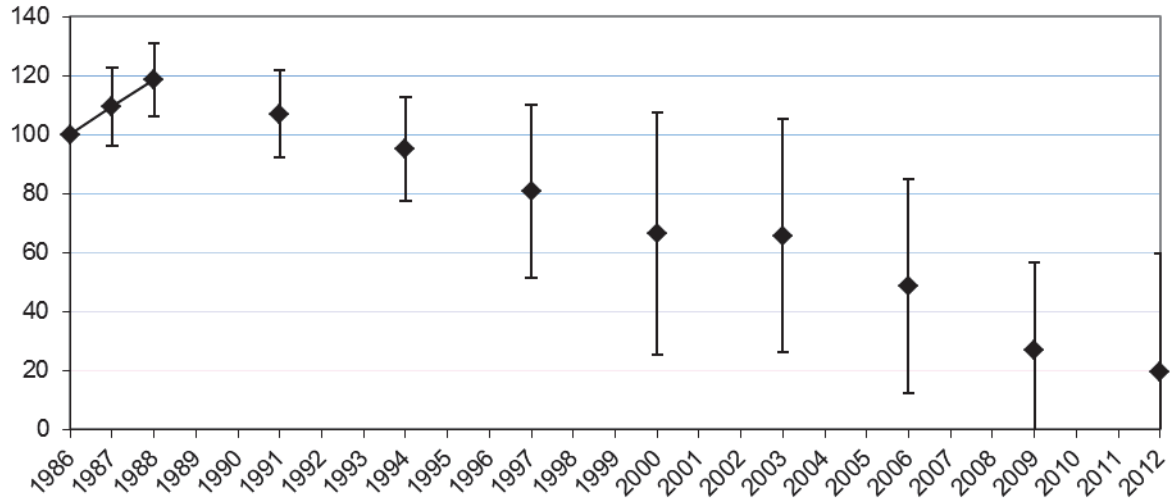

Figure 5. Population index for black-legged kittiwake AON at monitoring plots across all colonies in Orkney from 1986 – 2012 with 95% CLs. Counts were annual in 1986-1989 and then triennial. Graph reproduced from Mavor, 2012.

Apart from a small increase in population during 1986-1988, there has been a steady decline in numbers of breeding kittiwakes in study plots across Orkney. In 2012, the population index was under 20% of the 1986 baseline. The rate of decline has varied between the colonies, for example, Marwick Head has shown the slowest rate of decline while Mull Head no longer held any breeding pairs by 2012. Selected counts done in 2013 at various Seabird 2000 sections and a whole colony count carried out at Noup Cliffs Reserve on Westray indicate that the population may have fallen further by 2013 (see section 8.1).

Older monitoring studies indicate that the population has been in decline for a longer period. Kittiwakes declined steadily between 1980 and 1985, the overall annual index in 1985 was 63% of the 1976 level (Benn & Tasker, 1986). This demonstrates that the losses in breeding kittiwakes are even greater than shown in Fig. 5, and that they have been declining for longer than other monitored species in Orkney.

6. COMMON GUILLEMOT *URIA AALGE*

6.1 Breeding productivity

Common guillemots were monitored at two colonies, Marwick Head and Mull Head, between 25th May and 28th July.

6.1.1 Results 2013

Breeding success of guillemots this season is summarised in Table 6.

Table 6. Breeding success of common guillemots in Orkney in 2013. Large chicks and fledged refer to chicks that disappeared at 15 days or older.

	Active sites	Active and regular sites	Large chicks	Young fledged/active sites	Young fledged/active and regular	Mean productivity ± SE
Peedie Geo	57	63	6	0.11	0.10	0.10
Mull Head 1	17	21	3	0.18	0.14	
Mull Head 2	46	49	7	0.15	0.14	0.14 ± 0.00
Total	120	**133**	**16**	0.13	**0.12**	**0.12 ± 0.01**

Mean productivity was 0.12 “fledged” young per active and regular site, which is a decrease of 0.16 from 2012. The number of guillemots breeding in these plots in 2013 decreased by 21% from 2012. The season was very poor for guillemots, which was not reflected at other UK colonies such which all performed around the UK mean (ca. 0.66, Isle of May; Wanless, S. *pers comm.*) or higher (0.78, Bempton Cliffs; Aitken, D. *pers comm.*; ca. 0.8, Skomer Island; Birkhead, T. *pers comm.*).

Figure 6 shows breeding outcomes in 2013 by colony. The figure highlights differences between the two colonies: more pairs in the plots at Mull Head reached chick stage. A high proportion of pairs failed at egg at Marwick (62%), many during a short period (21st – 29th June). Mull Head was more productive than Marwick Head, fledging 0.14/active and regular pair compared to 0.10/active and regular pair. These differences could be linked to different predation pressures associated with position of plots on the colony. Great black-backed gulls, herring gulls and great skuas were very visible at both sites, but there was a regular perch in close proximity to the guillemots at Peedie Geo (Marwick) from which, both gull species were seen actively taking eggs and chicks. At Mull Head, gulls took abandoned eggs and were seen frequently landing in the colony. Numbers have declined at both colonies but Peedie Geo is a more exposed cliff face and located at the edge of the Marwick colony, whereas the Main Cliff plots at Mull Head are in the middle of a large cliff face and in the centre of the colony (see section 9.5).

In 2011, when breeding productivity was extremely low (mean 0.03), adult attendance at Peedie Geo was very poor, and it was hypothesised that this was linked to severe food shortages as very little food was observed coming into the plot. Multiple chicks were brooding under single adults or on the ledges alone (Thompson & Harding, 2011). Despite the poor productivity in 2013, adult attendance of chicks was good with only one chick recorded being brooded at a different site to its parents. Attendance of eggs was also good

although three occasions of an adult flying off the cliff or fighting with a neighbour and losing an egg were recorded.

Table 7. Breeding phenology of common guillemots in Orkney 2013

Colony	First egg	First chick	First 'fledge'
Marwick Head	24th May	27th June	25th July
Mull Head	24th May	20th June	5th July

Timing varied between the two colonies but generally breeding was late (table 7). Eggs were monitored from 24th May and the first chick hatched on 20th June at Mull Head and 27th June at Marwick Head. Young left the cliffs during 5th to 28th July. In 1990, fledging range was 5th to 29th July and this was described as late compared to patterns in 1983-1989 (Crossley, 1990), however, there are no recent fledgling range data available.

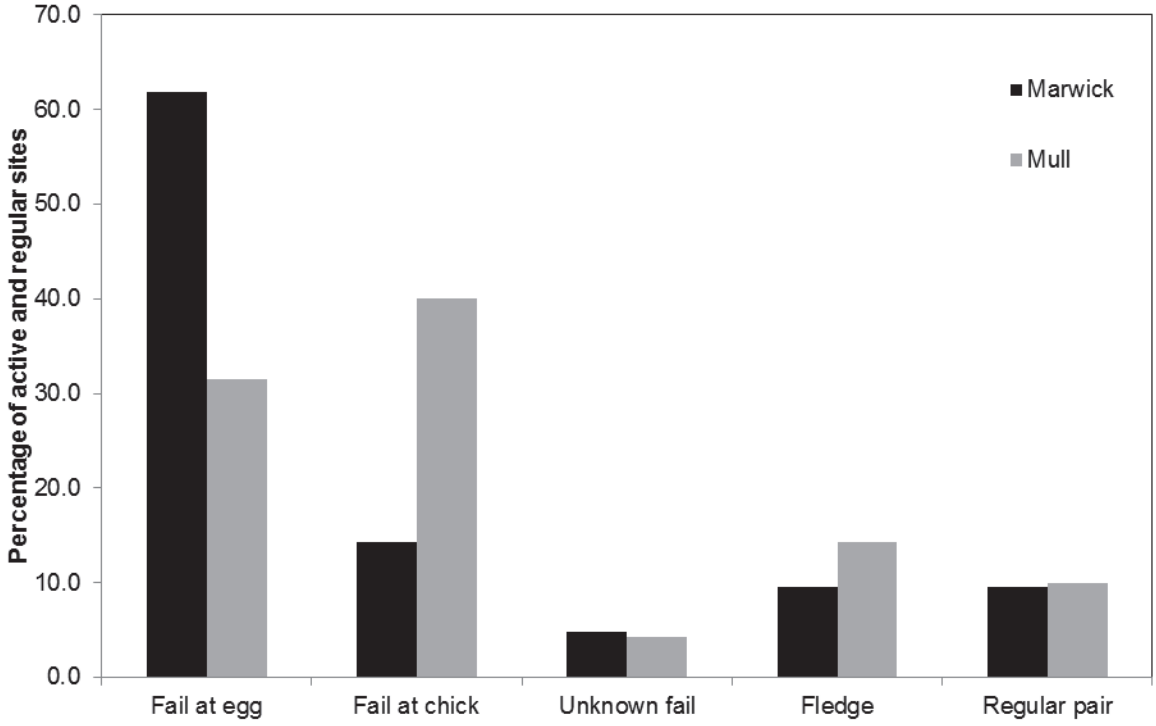

Figure 6. Active and regular pair outcomes at common guillemot colonies in 2013.

6.1.2 Breeding productivity 1986 – 2013

Breeding productivity has been recorded in Orkney since 1983, and the results are summarised in Figure 7.

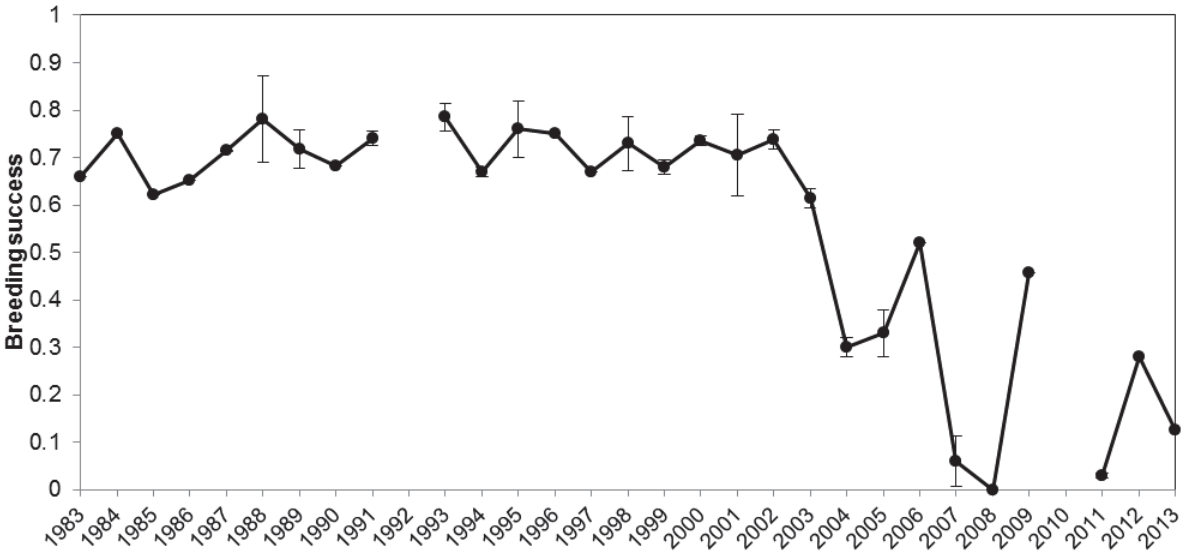

Figure 7. Breeding success (young 'fledged' per active and regular site) at Marwick Head and Mull Head. 1983-1988 and 2011 is Marwick Head only and no monitoring was carried out in 2010. No data are available for 1992.

Common guillemot breeding success in Orkney broadly follows a similar pattern to that seen in fulmars and kittiwakes over the same time period. Guillemot breeding productivity was stable around 0.7 during 1983 and 2002 (average 0.71). After this, there is a decrease in 2003 to 0.62 which was then the poorest productivity recorded. However, it fell further in 2004-2005, to 0.30 and 0.33 respectively. Productivity improved slightly in 2006 (0.52) but fell again in 2007 to 0.06 and there was complete breeding failure in 2008. These declines were seen in the north and east of the UK where sandeels are the dominant prey species, and coincided with food shortages (JNCC, 2013a). In 2009, productivity recovered again to 0.46 however in 20011, 2012 and 2013, productivity has been very poor. In 2011, almost complete breeding failure was observed at the Peedie Geo plot at Marwick Head as only 2 chicks reached jumping age and feeding and adult attendance was extremely poor (Thompson & Harding, 2011).

6.2 Chick diet and provisioning monitoring

6.2.1 Chick provisioning rate

In 2013, approximately 13 hours of feeding watches were carried out (~9 hours at Marwick Head and ~4 hours at Mull Head) between the hours of 0755 and 1125 during 3rd to 26th July. The mean feeding rate (± S.E.) was 0.27 (± 0.05) feeds/chick/hour (see annex 2 for more data). This is considered quite high given how few chicks made it to 15 days or older (Birkhead, T., *pers. comm*; Wanless, S., *pers. comm*). Apart from one watch where 16 chicks were present, the number of chicks monitored at a time was between 4 and 9. At Mull Head, 56% of provisioning events recorded during watches (n = 9) were to chicks that fledged and at Marwick Head, 72% of provisioning events recorded during watches (n = 18) were to chicks that fledged. Considering the small number of chicks monitored (and the biased proportion of chicks in that group that fledged), combined with other methodological issues, the feeding rate calculated may not be applicable to the earlier part of the season or more

widely across the colony. It could be that only the 'better' parents were monitored (see section 9.5).

6.2.2 Chick diet composition

Overall, 44 chick feeds were recorded during specific watches (n = 28) and during breeding monitoring (n = 16). Figure 8 depicts the composition of those feeds in species and size. Sandeels (*Ammodytes spp.*) were the main prey species delivered, making up 64% of observations made (n = 28). Medium-sized sandeels were the most commonly fed (1 – 1.5 bill lengths). The second most common prey were clupeids (most likely small herrings *Clupea harengus* or sprat *Sprattus sprattus*) representing 18% of prey species. Gadoids were not a common prey choice and were only seen being fed once. Seven feeds (16%) were unidentified in size and species.

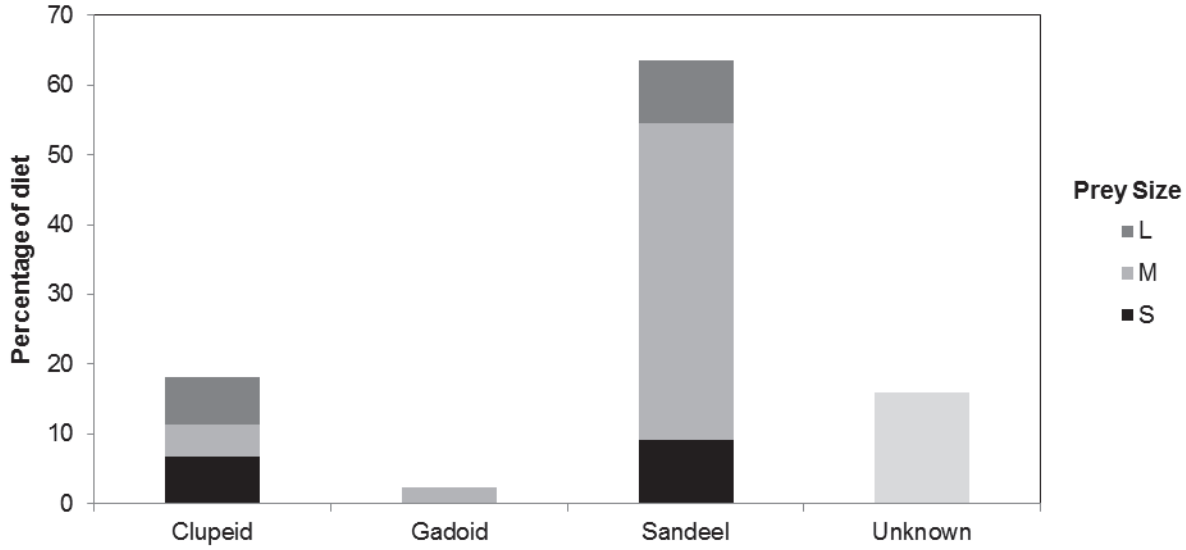

Figure 8. Chick diet composition from diet monitoring and other chick feeding observations at both colonies. Size classifications: S – small, < 1 bill length; M – medium, 1 – 1.5 bill lengths; L – large, ≥ 1.5 bill lengths.

Display fish were recorded on 11 occasions. Sandeels constituted 56% (6) of display fish, clupeids 36% (4) and gadoids 9% (1).

There are no recent data to compare these results to. The last time any work was done was in 1982-1988 and the methods are not directly comparable. In 1982, a more intensive study was done with continuous watch at Peedie Geo from 1800-2330 on 16th June and on the 17th June from 0230-1800. In that season, the median hatching date was 13th June and sandeels made up 99% of feeding events (151) with only 2 feeds of clupeids (Wanless *et al.,* 1983). During 1983-1988, observations were recorded throughout the chick-rearing period during productivity monitoring (see corresponding reports). Generally, a switch in food choice was observed around 20th June, when diet went from predominantly sandeels to a broader mixture of prey species. In 2013, in casual observations, only sandeels were seen being fed to guillemot chicks between 24th June and 8th July. After that, clupeids and a gadoid were fed as well as sandeels. During feeding watches, which did not begin until 3rd July, clupeids and a gadoid were fed as well as sandeels. This broadly agrees with patterns seen in 1983-1988, however the timing of this season was later in terms of hatch date, and the change in diet seems to take place at the end of June – beginning of July.

6.3 Breeding numbers

6.3.1 Population monitoring

Guillemot population monitoring has been carried out across Orkney since 1986 by JNCC. The results are summarised up to 2012 in Figure 9 (Mavor, 2012).

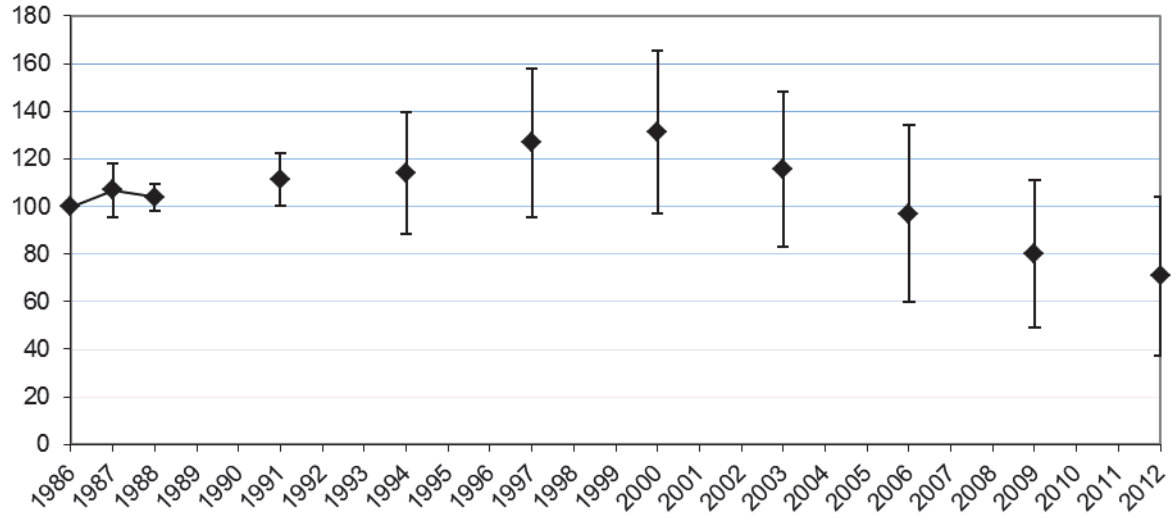

Figure 9. Population index for individual common guillemots at monitoring plots across all colonies in Orkney from 1986 – 2012 with 95% CLs. Counts were annual in 1986-1989 and then triennial. Graph reproduced from Mavor, 2012.

Older monitoring studies show that during 1976–1985, guillemot numbers at all colonies rose steadily until 1980-1981, and then began to decline (Benn & Tasker, 1986). The guillemot population index in 1985, based on the 1976 level, was at 126% (Benn & Tasker, 1986), indicating an overall increase in population during that period. From 1988, numbers slowly rose again and in 1997, guillemot numbers were about 50% higher than numbers recorded in 1976 (Thompson & Walsh, 2000). However, from 2000-2012 there has been a period of steady, significant decline at a rate of -5.0% per annum. In 2012, numbers at all colonies, with the exception of Mull Head, were at their lowest level since 1986 (Mavor, 2012). The population index in 2012 is 71% of the 1986 level. , Selected counts done in 2013 at various Seabird 2000 sections and a whole colony count carried out at Noup Cliffs Reserve indicate that the population across Orkney has fallen further below this level in 2013 (see section 8.1).

7. RAZORBILL *ALCA TORDA*

7.1 Breeding productivity

Razorbill breeding success was monitored in 2 plots at two colonies, Marwick Head (Peedie Geo) and Mull Head (Twisting Nevi), from 19th June – 2nd August 2013. The results are summarised in Table 8.

Table 8. Breeding success of razorbills in Orkney in 2013. Large chicks and fledged refer to chicks that disappeared at 15 days or older.

	Active sites	Active and regular sites	Large chicks	Young fledged/active sites	Young fledged/active and regular sites	Mean productivity ± SE
Peedie Geo	18	23	10	0.56	0.43	
Twisting Nevi	9	17	6	0.67	0.35	
Total	27	**40**	**16**	0.59	**0.39**	**0.39 ± 0.04**

The mean breeding productivity for both colonies was 0.39 'fledged' young per active and regular site. This is 29% lower than the UK average breeding success from 1986-2008. There was a high proportion of regular sites recorded (32.5%) and some pairs may have failed early on, for example at egg stage, and been missed because monitoring began later than it would normally as the plots was added a little late in the season. Hence the productivity figure may be an overestimate of how many chicks 'fledged' per active and regular site. From the two plots, 11 pairs failed, of which 5 were unknown fails. Only one pair was recorded to fail at egg stage, and 5 pairs apparently failed at chick stage., Productivity recorded on Mainland in 2013 compares favourably to 0.11 'fledged' per active and regular site recorded in North Hill RSPB reserve on Papa Westray.

7.2 Breeding numbers

Razorbill population monitoring has been carried out across Orkney since 1986 by JNCC. The results are summarised up to 2012 in Figure 10 (Mavor, 2012).

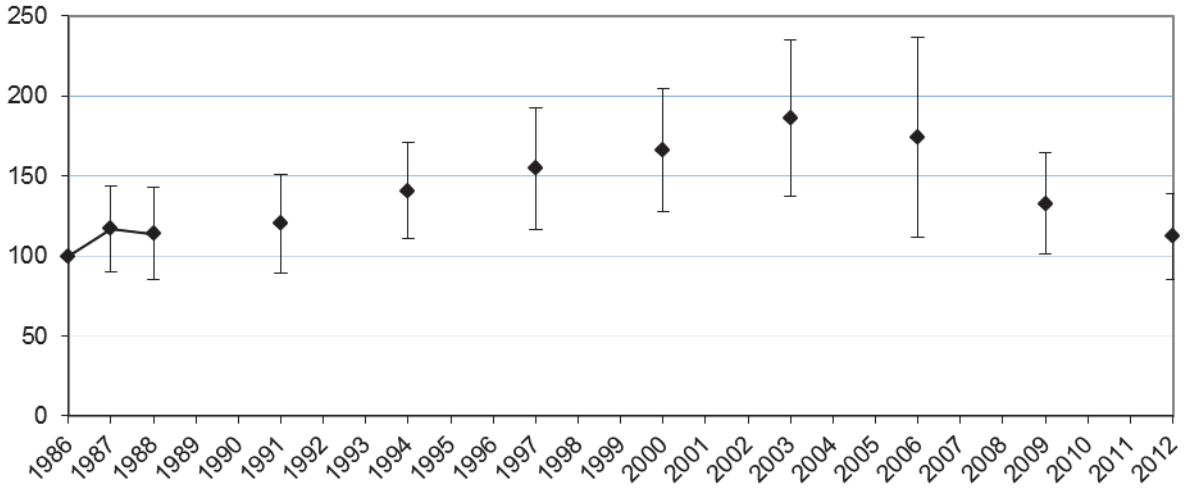

Figure 10. Population index for individual razorbills at monitoring plots across all colonies in Orkney from 1986 – 2012 with 95% CLs. Counts were annual in 1986-1989 and then triennial. Graph reproduced from Mavor, 2012.

Razorbill numbers increased from 1986-2003 overall, with fluctuations. Previous analysis shows that in 1997 the population index was around 75% higher than in 1976, indicating a long-term increase (Thompson & Walsh, 2000). This was not seen at all colonies,: Row Head declined overall between 1976-1997 (Benn & Tasker, 1986; Thompson & Walsh, 2000), and more recently, suffered the worst declines of all colonies between 2009-2012 (Mavor, 2012). Numbers at all colonies have decreased steadily but significantly from 2003-2012 at a rate of -5.5% per annum (Mavor, 2012). The population index in 2012 was at 112% of the 1986 baseline level. Selected counts done in 2013 at various Seabird 2000 sections and a whole colony count carried out at Noup Cliffs Reserve indicate that the population across Orkney may have fallen below this figure in 2013 (see section 8.1).

8. OTHER MONITORING WORK IN ORKNEY

8.1 Whole colony counts and censuses

Collating and analysing whole colony count data for Orkney is fraught with issues. Some data have been collected (see section 9.8.1 and annex 3); however, it is difficult to compare between years since methods of collection and areas covered are not always known. When extracting data from the Seabird Monitoring Programme online database there are gaps in information and sometimes the counts conflict with other data.

In 2013, a few sections of Seabird 2000 were repeated on Mainland Orkney and a whole colony count was carried out at Noup Cliffs reserve by the RSPB. This provided an indication of the state of seabird colonies in 2013. The combined results at these sites, including Noup Cliffs, show large decreases in breeding seabirds. Since Seabird 2000, kittiwakes showed a dramatic 87% fall in breeding numbers, common guillemot numbers fell by 46%, and razorbills fell by 57%. Although this season was atypical, as it was a late spring and was preceded by prolonged, stormy weather; the declines reported are consistent with the current negative trend of breeding seabirds in Orkney. Figure 11 shows declines in numbers of kittiwakes and guillemots at Noup Cliffs RSPB reserve since 1994. However, declines at this colony over this time frame this should be interpreted cautiously, due to the substantial expansion of the Noup Cliffs gannet colony.

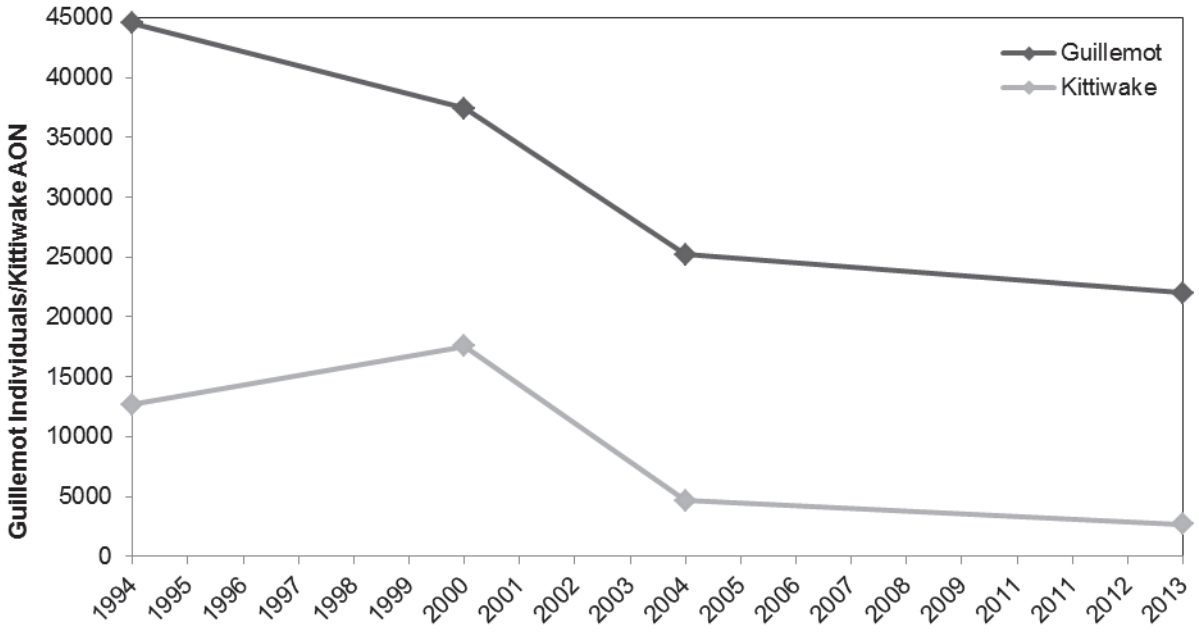

Figure 11. Numbers of common guillemot individuals, and numbers of kittiwake AON at Noup Cliffs since 1994, based on whole colony count data, collected from land.

8.2 Monitoring work on RSPB reserves

Specific seabird monitoring on reserves such as colony counts and entire reserve surveys follow the Seabird Monitoring Handbook methodologies. These are supplemented with additional data between full colony surveys that is collected annually (from transects, vantage points and ad-hoc information using standard recording units but not necessarily following standard methodology). This data is used to build a picture of species fortunes on RSPB reserves in between full colony surveys. Productivity monitoring is carried out annually following standard methodologies at Marwick (as part of the mainland productivity plots set up by JNCC) and North Hill (by reserve staff). The growing Northern gannet colony at Noup Cliffs Reserve is also monitored annually by reserve staff (method 2).

Productivity monitoring of other species at Noup is attempted when resources allow. Additionally, some monitoring of fulmars, shags, kittiwakes, and guillemots was carried out on Copinsay in recent years during the FAME/STAR seabird tracking work. Where possible this followed standard methodologies, however this was restricted by transportation logistics of getting to and staying on the island. See Annex 4 for a full breakdown summary of all population monitoring work on RSPB reserves.

8.3 Monitoring work outwith RSPB reserves

Table 9 summarises current monitoring work that is known to be taking place by third parties off-reserves.

Table 9. Summary of other monitoring work done around Orkney, mostly anecdotal from occasional monitoring

Location	Species	Researchers
Stroma	Black guillemot	Elizabeth Masden
Hoy	Northern fulmar	Ewan Edwards
Hoy – Stourdale	Great skuas	Chris Booth
Auskerry	Fulmar, shag, Arctic skua, kittiwake, common gull, herring gull, great black-backed gull, Arctic tern, guillemot, razorbill, black guillemot, puffin	Chris Booth
Sanday	Unknown	Rod Thorne
Westray	Unknown	Don Otter
Eday	Unknown	Mike Cockram
North Ronaldsay	All present species	NRBO
Shapinsay	Fulmar, black guillemot, cormorant, Arctic tern, sandwich tern, black-headed gull, common gull, herring gull, red-throated diver	Paul Hollinrake (RSPB)
Eynhallow	Northern fulmar	Paul Thomson
Grassholm	Black Guillemot	Paul Hollinrake & Alan Leitch
Rousay	Kittiwake	RSPB

9. REVIEW AND RECOMMENDATIONS

9.1 Summary

1. Replace fulmar plot photos as detailed below.
2. European shag monitoring should be continued, commencing from mid-April (or as early as possible) next season.
3. All extensions and new plots for kittiwakes were successful and should be monitored again next season to confirm that these are effective.
4. Continue kittiwake monitoring at Row Head and Gultak until these colonies go extinct and always highlight if results are skewed due to small plot sizes.
5. Monitor and record phenology of key breeding events for kittiwakes and guillemots. For kittiwakes, use Peedie Geo as an example plot.
6. Guillemot diet and chick provisioning monitoring should be continued. Methods should be standardised and planned before next season, and monitoring should start as soon as there are enough chicks present in plots.
7. Razorbill monitoring should be continued next season, and visits increased to approximately the same frequency as guillemots.

9.2 Northern fulmar

Plot photos at Ramna Geo at Costa Head and Main Cliff at Gultak need to be replaced.

In 2012, some of the final visits had many medium-sized chicks still present in the colonies, which were assumed to have fledged. However, in 2013, quite a few medium-sized chicks disappeared between fortnightly visits despite many others remaining on the cliff. It is therefore highly recommended that medium-sized chicks are followed up and that is done approximately two weeks after the previous visit as the seabird monitoring handbook suggests. Since age classification of fulmar chicks can be quite subjective, it could also be valuable to make a note on what sorts of chicks are getting classified as small, medium or large. This should be done in consideration that chicks are assumed to have fledged if last seen as large or downy but adult-sized.

9.3 European shag

Monitoring of European shags is valuable and should continue. Currently, there is no apparent trend in productivity nationally; yet nationwide breeding abundance is declining (JNCC, 2013a). Monitoring in 2013 started late and in future should follow the Seabird Monitoring Handbook recommendation of starting in mid-April. The plots were conveniently located and Facing Brough held enough breeding pairs. Twisting Nevi only held 9 AON in 2013 (cf 10-30 nests as recommended in Walsh *et al.,* 1995). In the future, it might be beneficial to monitor this and look for additional plots, since only one colony is monitored (Mull Head) and productivity might vary locally (section 4.1).

9.4 Black-legged kittiwake

New breeding plots and breeding plot extensions fitted in successfully to the current monitoring programme, and they are shown in Annex 7. The extension at Above Cave provided the smallest increase in AON; with only 7 being added (plus 6 trace nests). In better seasons, this may be more and it would be worth looking at this in future seasons to determine whether this extension makes a sufficient difference. The other extensions and new plots had a reasonable number of AON within them. However, due to the poor season in 2013 it was difficult to determine if the extra plots and plot extensions would alleviate statistical problems of small plots and give any more information than already gained from the existing plots. Therefore, it is recommended that these be continued next season.

Plot extensions were carried out ensuring that original boundaries were noted and photographs were kept, and all nests in the extension were noted separately. Therefore, in future seasons, results can still be provided from the original set of plots and plots without extensions as well as the new set of plots and extensions.

Flexibility of visits is required for kittiwakes particularly in an atypical season. In 2013 extra visits were made in early June, as so few nests had been completed in the previous visit. This allowed easier documentation of nests that failed at egg stage, or before they had laid. However, an extra visit just after hatching would have been valuable as it was suspected that nests failing very soon after hatch might have been missed. With so many kittiwake nests failing it would be good to get a handle on how many nests are failing at each stage, or at least be aware of which fails recorded are likely to be an over or under-estimate.

It would be valuable to record timings of certain key events during the breeding season (breeding phenology), allowing timing between seasons to be compared in the long term. Information such as first egg, first chick, first fledge, last fledge could be easily recorded. Since the plots are visited relatively infrequently, it could be useful to use Peedie Geo as an example for timings, as this is visited very frequently for guillemot work.

9.5 Common guillemot

The breeding monitoring plot at Peedie Geo has always been in the edge of the Marwick colony, which could affect the productivity results and not be representative of Marwick Head as a whole. In the future, it could be worthwhile to measure guillemot density in plots across the whole colony and compare Peedie Geo to the average (Tasker, 1983). This would give an indication of how different the edge of the colony is to the rest. It is worth recording any predation events and adult attendance of chicks. Breeding phenology should be recorded and reported as this allows comparisons of timing between seasons to be made and can indicate an atypical breeding season.

Monitoring chick diet and chick provisioning rate in future seasons would be valuable. At Peedie Geo, these data were collected in 1982 (see method below) and casual chick diet observations only were recorded during 1983-1988. It is carried out at other UK colonies (Isle of May, Bempton Cliffs, Skomer Island) and could be compared easily. In 2013, many chicks failed early on and there were not many chicks on the cliffs. Next season, it would be better to begin this monitoring as soon as there were enough chicks on the cliffs (depending on the methods used).

Methods are currently carried out in many different ways at different colonies:

1. Isle of May as described by Sarah Wanless (see section 2), where monitoring takes place throughout chick-rearing for 2-hour periods in the early morning
2. Bempton Cliffs RSPB reserve where four plots are monitored in two-hour shifts, with volunteers on a rotation. Each plot is sampled on the same day to account for weather conditions and other issues affecting bird foraging that might vary day to day. Over the whole study period, each plot is monitored on each time slot, to account for differences in feeding behaviour at different times of day (Aitken, D., *pers. comm.*).
3. Skomer Island, where a plot is watched intensively for 4-hour shifts over a 2-day period from first light until dark, once chicks in the plot have reached c. 12 days old (Birkhead, T., *pers. comm.)*.
4. Marwick Head in 1982: Peedie Geo was watched intensively for 24 hours in mid-June: on one day from 1800 – 2330, then the following day from 0230 – 1800 (Wanless *et al.,* 1983).

9.6 Razorbill

Monitoring of razorbills is valuable and should continue. The plots fitted well into the current monitoring programme and contained a substantial number of occupied sites (Seabird Monitoring Handbook recommends 3-5 plots of 10 or more). Early on when the plots were being trialled, visits were less frequent but after this, frequency was increased. It is recommended that next season the plots are visited at the same frequency as the guillemot plots. Razorbill breeding numbers are being recorded in triennial population monitoring by JNCC and so productivity data would complement this.

It is worth collecting data on any chick feeding events observed during productivity monitoring, however in 2013, very few feeding events were seen.

9.7 Other recommendations and issues

- High-resolution **photographs** should be taken of all plots and cliff-faces containing plots as part of an evidence base. This work was not fully carried out in 2013 due to other work and irregularity of the season's timing
- The plot photos could be organised on a map which links colonies to data and corresponding photo catalogue using a GIS mapping programme.
- An attempt to collate available **whole colony count data** since Operation Seafarer (OS) was made; however, there are many issues with this. Data from OS was collected in different ways, often not recorded, and some counts were extremely general, particularly at Marwick Head. At Noup Cliffs and Marwick Head RSPB reserves, reserve and SPA boundaries are different, and in some cases, it is not possible to distinguish where the numbers have come from. Data from different sources show conflicting results. The information that was gathered (and its sources) is compiled in annex 3. However, there are gaps and the counts are not necessarily comparable across years.
- Monitoring of **Arctic terns** was discussed, but due to difficulty finding any colonies on Mainland large enough to be worth recording, this was not carried out. However, Skipi Geo (east of the Brough of Birsay) should be considered in future seasons. Although it is not a large colony, it could be monitored easily as there are a few good vantage points. Counts of adults and fledglings were undertaken here in 2013
- Should any form of **tern population monitoring** go ahead, it would require a co-ordinated effort across Mainland, and methods should follow methods carried out in Seabird 2000.
- There was some confusion across reports in how **productivity** was reported. Older reports have recorded it differently and in some cases, it had to be re-calculated.
- Means should be calculated as stated in section 2 and Walsh *et al.,* 1995. Ideally, both summed means and means of plot figures would be provided for extra detail.
- **Fulmar population** changes are not clear and merit further investigation. Population monitoring shows an overall decline, however in Seabird 2000 sections counted in 2013 large increases were seen in some discrete areas. Population monitoring distinguishes more clearly between AOS and loafing, non-breeding adults but care must be taken when extrapolating from changes in the combined colony index to the population as a whole.

9.8 Historic data collation

An attempt was made to gather all productivity data, population monitoring data and whole colony census data. Data collated on productivity can be found in Annex 3. Productivity data from 1986-2008 were provided by Roddy Mavor at JNCC, with some exceptions. These data are also available to colony level (mostly) but not reported here. Population monitoring data were also sourced from Roddy Mavor at JNCC and are not repeated in this report. Whole

colony data were sourced mostly from the Seabird Monitoring Programme website, with exceptions, see notes in Annex 3.

Copies of all reports done as part of the JNCC Seabird Monitoring Programme and other seabird work in Orkney are found either in the RSPB office or in the Scottish Natural Heritage office. A list of all the reports or journal articles and their locations can be found in Annex 5.

For future reference, there is a wealth of information on Orkney productivity and colony counts going back to 1986 available on the JNCC SMP website (JNCC, 2013b), although there is restricted access to breeding data. For some locations data are very detailed, including plot-level reporting of productivity. In addition, there is some information available in annual seabird summaries written by Eric Meek, formerly of the RSPB.

9.8.1 Identifying the gaps and issues

Kittiwake productivity monitoring was initiated at Marwick Head in 1986, using a mapped nests method. This was carried out in two plots, Peedie Geo and Front (disused plot) until 1988. In 1989, the full quota of breeding plots across the five colonies was introduced. During this time, breeding success of kittiwakes was also estimated across all five colonies in the population monitoring plots. This was done by dividing the total number of chicks present in mid-July (prior to first fledging) by the peak count of AON in June. Therefore, there are two conflicting sets of data for this time. The more intensive data from Marwick have been used in this report as the methods are more comparable with the rest of the monitoring programme. Kittiwake productivity was not calculated from historic reports earlier than 1986.

Guillemot productivity data are available for all years monitored, excluding 1992. However, these data are missing details including number of AOS/AON/active pairs and total number fledged. These gaps are clear within the datasheets and could be explored further by reviewing historic reports.

Population monitoring data before 1989 can be found in the report by P. Hope Jones (1978) and the summary by Benn and Tasker (1986) is useful.

There are gaps in information about the whole colony counts in Orkney (see section 8.1 and annex 3). Grid references, section labelling and method of count will have to be reviewed in full for each count before meaningful comparisons can be made. The paper by Thompson and Walsh (2000) is useful for periods during 1979-1997. The Operation Seafarer count data is full of problems making it difficult to use. The original count sheets can be found in the RSPB office for that and for the Seabird Colony Register. Data were obtained from JNCC on all counts undertaken between 1969 and 1998 but some of these data contradict other sources.

10. REFERENCES

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ANNEX 1: SPECIES BREEDING SUCCESS DATA

Table 10. Northern fulmar breeding success 2013

Site	Plot	AOS	Fail before first check	Fail at chick (known)	Fledge	Last seen M	Young fledged/AOS
Costa Head	West	42	14	3	25	8	0.60
	Standard	35	14	0	21	5	0.60
	Ramna Geo	54	32	0	22	6	0.41
	Total	131	60	3	68	19	0.52
Mean ± SE	**0.53 ± 0.06**						
Gultak	Geo Up	28	20	0	8	0	0.29
	Geo Down	42	18	1	23	1	0.55
	Second Geo	22	14	0	8	0	0.36
	Main Cliff	27	19	0	8	2	0.30
	Total	119	71	1	47	3	0.39
Mean ± SE	**0.37 ± 0.06**						
Mull Head	Brough	36	19	1	16	1	0.44
	White Fowl Nevi	27	20	0	7	0	0.26
	Main Cliff	11	7	1	3	0	0.27
	Twisting Nevi Left	33	24	0	9	1	0.27
	Twisting Nevi Right	46	33	1	12	0	0.26
	Total	153	103	3	47	2	0.31
Mean ± SE	**0.30 ± 0.04**						
Overall Totals		**403**	**234**	**7**	**162**	**24**	**0.40**
Overall Mean ± SE	**0.40 ± 0.07**						

Table 11. Black-legged kittiwake breeding success in 2013

Site	Plot	AON	Trace	Empty/ abandoned	Failed (had clutch)	Fail at chick	Unknown fail	Fledge	Young fledged/AON
Costa Head	Main Face	16	6	8	8	0	0	0	0
	Above Cave	21	9	9	11	0	1	0	0
	Ramna Geo Outer Left	16	1	15	1	0	0	0	0
	Ramna Geo Outer Right	2	6	2	0	0	0	0	0
	Total	55	22	34	20	0	1	0	0
Mean ± SE	**0**								
Brough of Birsay	East	49	1	25	19	1	4	0	0
	West	36	15	20	14	0	2	0	0
	Total	85	16	45	33	1	6	0	0
Mean ± SE	**0**								
Marwick Head	North End Upper	58	7	27	25	4	2	0	0
	North End Mid	30	4	10	16	4	0	0	0
	North End Lower	30	3	8	18	3	2	0	0
	Monument Upper	10	3	6	2	2	0	0	0
	Monument Lower	26	3	14	6	5	1	0	0
	Peedie Geo	18	6	5	7	4	2	0	0
	Total	172	26	70	74	22	7	0	0
Mean ± SE	**0**								
Row Head	Blossom	2	1	0	2	0	0	0	0
	Yettna New	6	2	3	1	1	1	0	0
	Total	8	3	3	3	1	1	0	0
Mean ± SE	**0**								

Site	Plot	AON	Trace	Empty/ abandoned	Failed (had clutch)	Fail at chick	Unknown fail	Fledge	Young fledged/AON
Gultak	New Plot 03	5	1	1	2	1	0	1	0.2
Mean ± SE	**0.2**								
Overall Totals		**325**	**67**	**153**	**133**	**25**	**15**	**1**	**0.003**
Overall Mean ± SE	**0.04 ± 0.04**								

Table 12. Black-legged kittiwake breeding success in 2013 excluding extensions and new plots

Site	Plot	AON	Trace	Empty/ abandoned	Failed (had clutch)	Fail at chick	Unknown fail	Fledge	Young fledged/AON
Costa Head	Main Face	16	6	8	8	0	0	0	0
	Above Cave	14	3	7	7	0	0	0	0
	Ramna Geo	16	1	15	1	0	0	0	0
	Outer Left Ramna Geo Outer Right	2	6	2	0	0	0	0	0
	Total	48	16	32	16	0	0	0	0
Mean ± SE	**0**								
Marwick Head	North End	42	6	21	18	3	0	0	0
	Monument Upper	10	3	6	2	2	0	0	0
	Monument Lower	11	3	3	2	5	1	0	0
	Peedie Geo	18	6	5	7	4	2	0	0
	Total	81	18	35	29	14	3	0	0
Mean ± SE	**0**								
Row Head	Blossom	2	1	0	2	0	0	0	0
	Yettna New	6	2	3	1	1	1	0	0
	Total	8	3	3	3	1	1	0	0
Mean ± SE	**0**								
Gultak	New Plot 03	5	1	1	2	1	0	1	0.2
Mean ± SE	**0.2**								
Overall Totals		**142**	**37**	**71**	**51**	**16**	**4**	**1**	**0.007**
Overall Mean ± SE	**0.04 ± 0.04**								

ANNEX 2: GUILLEMOT CHICK DIET AND PROVISIONING DATA

Table 13. Guillemot chick provisioning rate data.

Watch	Date	Site	Length (minutes)	Weather	No. Chicks	Feeding events	feeds/chick /hr
1	03/07/2013	Mull 2	60	F3, showers	16	6	0.38
2	05/07/2013	Marwick	60	-	8	0	0.00
3	06/07/2013	Marwick	80	F2, fine	9	2	0.17
4	10/07/2013	Mull 2	90	F1, cloudy	8	3	0.25
5	11/07/2013	Marwick	120	F1, fog	9	3	0.17
6	12/07/2013	Mull 2	100	F1, fine	8	1	0.08
7	18/07/2013	Marwick	60	F4, fine	7	3	0.43
8	20/07/2013	Marwick	60	F1, fine	7	2	0.29
9	22/07/2013	Marwick	120	F1, fine	7	6	0.43
10	26/07/2013	Marwick	60	F1, mist	4	2	0.50
						MEAN ± SE	**0.27 ± 0.05**

Table 14. Guillemot chick diet composition from feeding watches and casual observations. Size classifications: S – small, < 1 bill length; M – medium, 1 – 1.5 bill lengths; L – large, ≥ 1.5 bill lengths.

Species	No. feeds	%	Size	No. feeds	%
Clupeid	8	18.18	**S**	3	37.50
			M	2	25.00
			L	3	37.50
Gadoid	1	2.27	**S**	0	0.00
			M	1	100.00
			L	0	0.00
Sandeel	28	63.64	**S**	4	14.29
			M	20	71.43
			L	4	14.29
Unknown	7	15.91	n/a		

Table 15. Guillemot display fish recorded. Size classifications: S – small, < 1 bill length; M – medium, 1 – 1.5 bill lengths; L – large, ≥ 1.5 bill lengths.

	Number observed	S	M	L
Clupeid	4	0	2	2
Gadoid	1	0	0	1
Sandeel	6	1	4	1
Total observed	**11**	**1**	**6**	**4**

ANNEX 3: HISTORIC DATA

Table 16. Mean productivity of northern fulmar (FU), black-legged kittiwake (KI) and common guillemot (GU) in Orkney since 1983.

Year	Fulmar		Kittiwake		Guillemot		Comments	Source
	Mean	S.E.	Mean	S.E.	Mean	S.E.		
1983					0.66		Peedie Geo, Lower ledges plot. Monitoring finished early.	Re-calculated from Tasker, 1983
1984					0.75		Peedie Geo, Lower ledges plot. KI data but not calculated	Re-calculated from Griffiths, 1984
1985					0.62		Peedie Geo, Lower ledges plot. KI data but not calculated	Re-calculated from Benn, 1985
1986			1.04	0.27	0.65		GU: Peedie Geo, Lower ledges plot. KI: Peedie Geo and Front plots	Re-calculated from Beveridge, 1986
1987			1.26	0.18	0.71		GU: Peedie Geo "Lower ledges" KI: Peedie Geo and Front plots	Re-calculated from Ward, 1987
1988			0.98	0.18	0.78		GU: Peedie Geo, Lower ledges plot. KI: Peedie Geo and Front plots	Re-calculated from Thomas, 1988
1989	*0.37*	*0.07*	0.81	0.10	0.72	0.00	Fulmar: Methods not directly comparable	JNCC and see Ribbands,1990
1990	0.43	0.02	0.94	0.08	0.68	0.09	KI: excludes Costa Head	JNCC
1991	0.49	0.03	1.09	0.08	0.74	0.04		JNCC
1992	0.50	0.04	1.22	0.08			KI: excludes Costa Head. GU: no data found.	JNCC
1993	0.48	0.04	0.83	0.07	0.79	0.02	KI: excludes Costa Head	JNCC
1994	0.49	0.06	1.05	0.08	0.67	0.02	KI: excludes Costa Head	JNCC
1995	0.51	0.02	1.23	0.04	0.76	0.03	KI: excludes Costa Head	JNCC
1996	0.46	0.02	1.18	0.03	0.75	0.01	KI: excludes Costa Head	JNCC
1997	0.39	0.10	1.23	0.15	0.67	0.06	KI: excludes Costa Head	JNCC
1998	0.44	0.04	1.09	0.05	0.73	0.00		JNCC
1999	0.46	0.02	1.06	0.03	0.68	0.00		JNCC
2000	*0.43*	*0.05*	0.93	0.13	0.74	0.06	FU: AOS based on only a single visit made in June	JNCC
2001	0.46	0.01	0.94	0.12	0.71	0.01		JNCC
2002	0.48	0.00	1.04	0.02	0.74	0.01	GU: from JNCC and Meek report	RSPB Seabird summary, Eric Meek

2003	0.30	0.06	0.60	0.06	0.62	0.08		JNCC
2004	0.08	0.01	0.00	0.00	0.30	0.02		Paice, D. 2009
2005	0.46	0.02	0.72	0.01	0.33	0.02		Paice, D. 2009
2006	0.43	0.04	0.52	0.03	0.52	0.02		Paice, D. 2009
2007	0.20	0.04	0.00	0.00	0.06	0.05		Paice, D. 2009
2008	0.29	0.02	0.00	0.00	0.00	0.00		Paice, D. 2009
2009	0.43	0.04	0.50	0.13	0.46	0.05		Paice, D. 2009
2010							No monitoring carried out this year due to lack of funding	
2011			*0.00*		*0.03*		GU and KI: Marwick plots only, monitored by volunteers	Unpublished report: Thompson, K. And Harding, N. 2011
2012	0.41	0.07	0.13	0.09	0.28	0.06	FU: assumes all M chicks fledge	Unpublished RSPB report: Stoneman, J. 2012
2013	0.40	0.07	0.04	0.04	0.13	0.01	KI: includes all extensions and new plots	*Pers. obs.*

Table 17: Whole colony count data gathered from Seabird Monitoring Programme website and other sources. See explanatory notes below.

Colony	Species	1969	1979	1981	1985	1986	1987	1991	1994	1997	1998	1999	2000	2002	2003	2004	2006	2009	2011	2012	2013
Marwick	**Fulmar**	350				1285		775				823				330	346			620	
Marwick	**Shag**	10				7						12					8			7	
Marwick	**Kittiwake**	10000				5509		5698	5012	4543		5573			3860		2185	2018	1372	1134	526
Marwick	**Guillemot**	10000	27715			26350		30854				34679				10476				16562	
Marwick	**Razorbill**	1000				1108		1088				1446				238	350			769	
Row	**Fulmar**				256			236				180									
Row	**Shag**											0									
Row	**Kittiwake**			2549	2212			2606	2350	2099		1565	1398		929		597	248		98	
Row	**Guillemot**			6921	6103			8271				5900									
Row	**Razorbill**			189	142			162				140									
Costa	**Fulmar**	961			2548								2587								
Costa	**Shag**	34											5								
Costa	**Kittiwake***	2920		1796	1652			2673	2383	2038			1256		1436		1025	639		477	
Costa	**Guillemot***	550		7504	7492								9630								
Costa	**Razorbill***	40		771	673								533								
Gultak	**Fulmar**	1047			1035			1533					561								
Gultak	**Shag**	141			34								25								
Gultak	**Kittiwake**	1266			587			599	662	415			249		177		140	89		44	8
Gultak	**Guillemot**	2002			1799			2486					1810								
Gultak	**Razorbill**	310			492			760					247								
Mull	**Fulmar**	2356			312			361					230	272							180
Mull	**Shag**	231																			0
Mull	**Kittiwake**	1200		1392	1066			1283	1129	791	726		559	447	803		449	109		0	0
Mull	**Guillemot**	962		1390	1171			1593					1974	1452							1014
Mull	**Razorbill**	267			125			141					189	177							50
Noup	**Fulmar**	588				1620	562		1129				1067			516					530
Noup	**Shag**	103											18			8		9			14
Noup	**Kittiwake**	38451				22150	12323		12706				17546			4698					2683
Noup	**Guillemot**	54480				44780	21775		44529				37390			25237					22003
Noup	**Razorbill**	2556											1088			898					614

Notes: Operation Seafarer (OS - 1969) data from R. Mavor at JNCC. Counts are “best estimate” = Acc + half (min-max).
OS Costa Head Guillemot counts done in “part”.
OS Marwick Head guillemot, kittiwake and razorbill counts were stated as “Order 5” or “Order 4” only and not accurate counts.
OS Gultak includes Dingieshowe to Roseness
OS Noup Cliffs counts were almost certainly done from sea but this is not officially stated anywhere.

Sourced from Thompson, K.R. & Walsh, P.M. (2000): GU Marwick 1979; RA Marwick 1991; RA Row; FU Row 1985; KI Row 1981 and 1985; GU Mull and Gultak 1981, 1985, 1991; RA Mull 1985 and 1991; KI Mull 1981 and 1985; FU Mull 1985 and 1991; RA Gultak 1991
Costa Head GU, FU and KI 1981 may have excluded some areas and in 1985, max figure given
Noup Cliffs, Mull Head data and Kittiwake counts from 2013 courtesy of the RSPB
All other data from http://jncc.defra.gov.uk/smp/Default.aspx Accessed 05/09/2013

ANNEX 4: SEABIRD WORK ON RSPB RESERVES

Table 18. Summary of seabird population monitoring or counts done on reserve and methods used. Codes for different methods are provided at the foot of the table. Continues on following page. Information from Alan Leitch, Reserves Manager.

Species	Birsay Moors	Hobbister	Cottascarth	Rendall Moss	Loons	Loch of Banks	Brodgar	Marwick Head	Copinsay	North Hill
Red-throated diver	O	O								
Northern fulmar		C - 2000						C - 2012	C – 2008 (+ boat)	C - 2013
European storm-petrel									C – 2000, A	
Manx shearwater										
Northern gannet										
European shag								C - 2012	C - 2008	C - 2012
Great cormorant										
Great skua	C – 2010 T,V,A	C – 2010 T,V,A							C – 2010 V,A	C – 2010 V,A
Arctic skua	C – 2010 T,V,A									C – 2010 V,A
Common gull	C – 2000 T,V,F,A	C – 2000 T,V,F,A		C – 2000 V,A	C – 2000 V,A	C – 2000 V,A	C – 2000 V,A		C – 2000 F,V,A	C – 2000 V,A
Herring gull	C – 2000 T,V,F,A	C – 2000 T,V,F,A						C – 2012	C - 2008 F,V,A	C – 2000 V,A
Lesser black-backed gull	C – 2000 T,V,F,A	C – 2000 T,V,F,A								C – 2000 V,A
Great black-backed gull	C – 2000 T,V,F, A	C – 2000 T,V,F,A							C – 2008 F,V,A	C – 2000 V,A
Black-headed gull	C – 2000 V, A				C – 2000 V,A	C – 2000 V,A	C – 2000 V,A			
Black-legged kittiwake								C - 2013	C – 2008	C - 2012
Little tern										
Arctic tern		C – 2000 F,V,A							C – 2008 F,V,A	C – 2000 V,F
Common tern		C – 2000 F,V,A								
Sandwich tern										
Common guillemot								C - 2012	C1 - 2008	C - 2012
Razorbill								C - 2012	C1 - 2008	C - 2012
Black guillemot		C - 2013							C - 2009	C - 2013
Atlantic puffin								A - 2011/12	C3 - 2011	

Species	Noup Cliffs	Hoy	Mill Dam	Onziebust	Trumland	Comments
Red-throated diver		O			O	All suitable lochans checked annually for AOS, then later for presence of chicks as per Gilbert *et al*. 1998. Last national survey undertaken in 2006.
Northern fulmar	C - 2013	C - 2000			A	Only North Hill has been annually assessed
European storm-petrel						Known to be present in small numbers on Copinsay
Manx shearwater		A				Former small colony, current status unknown
Northern gannet	C2 - 2013					Land Based Annual Counts and numbers of viable young counted.
European shag	C - 2013	C - 2000				Not surveyed annually
Great cormorant						
Great skua		C - 2010			C – 2010 V,A	Only a single visit was undertaken for the skua census 2010 due to impracticalities of covering whole Orkney archipelago. This is in line with previous skua census's on Orkney
Arctic skua						Only a single visit was undertaken for the skua census 2010 due to impracticalities of covering whole Orkney archipelago. This is in line with previous skua census's on Orkney
Common gull		C – 2000, A			C – 2000 V,A	
Herring gull	C – 2013, A	C – 2000, A			C - 2000 V,A	Mixed colonies are estimates
Lesser black-backed gull					C – 2000 V,A	Mixed colonies are estimates
Great black-backed gull		C – 2000, A			C – 2000 V,A	
Black-headed gull				C – 2000		
Black-legged kittiwake	C - 2013	C - 2000				Only generally covered during colony counts
Little tern						
Arctic tern			C – 2000	C – 2000		Virtually gone on all sites
Common tern						Odd pair historically only
Sandwich tern						
Common guillemot	C - 2013	C - 2000				Not surveyed annually
Razorbill	C - 2013	C - 2000				Not surveyed annually
Black guillemot		C - 2000				Not surveyed annually
Atlantic puffin	C3 - 2013	C - 2000				Not surveyed annually

Codes: C – census by land unless otherwise stated (JNCC methodology – number refers to method), T – transect, V – vantage point count, F – flush count, A – anecdotal, O – other (see comments). Shaded red – not present on reserve. Shaded green – present on the site within past 5 years.

ANNEX 5: LIST OF ALL WRITTEN WORK AVAILABLE ON THE SEABIRD MONITORING PROGRAMME IN ORKNEY SINCE 1976

Table 19. All known seabird reports and other work, and their location

Year	Author	Title	Location/format
1976-1977	Hope Jones, P.	Surveillance of Cliff-nesting Seabirds at their Breeding Sites: A Draft Report on Work Done in Orkney	RSPB Office, paper
1976-1980	Wanless, S., French, D., Harris, M. & Langslow, D.	Detection of Annual Changes in the Numbers of Cliff-nesting Seabirds in Orkney [journal article]	RSPB Office, paper
1976-1978	Hope Jones, P.	Surveillance of Cliff-nesting Seabirds at their Breeding Sites in Orkney, 1976-78	RSPB Office, paper
1982	Wanless, S., Reynolds P. & Langslow, D.	Surveillance of Cliff-nesting Seabirds in Orkney	SNH Office
1983	Tasker, M.	Surveillance of Cliff-nesting Seabirds in Orkney	SNH Office
1984	Griffiths, A.	Surveillance of Cliff-nesting Seabirds in Orkney	RSPB Office, paper and PDF
1985	Benn, S.	Surveillance of Cliff-nesting Seabirds in Orkney	RSPB Office, paper
1985	Benn, S. & Tasker, L.	Surveillance of Cliff-nesting Seabirds in Orkney, 1976 - 1985	SNH Office
1986	Beveridge, F.	Surveillance of Cliff-nesting Seabirds in Orkney	RSPB Office, paper
1987	Ward, R.	Surveillance of Cliff-nesting Seabirds in Orkney	RSPB Office, paper
1988	Thomas, C. J.	Surveillance of Cliff-nesting Seabirds in Orkney	RSPB Office, paper
1989	Ribbands, J. B.	Monitoring of Breeding Success of Cliff-nesting Seabirds in Orkney in 1989	RSPB Office, paper and PDF
1990	Crossley, J.	Monitoring of Breeding Success of Cliff-nesting Seabirds in Orkney in 1990	RSPB Office, paper and PDF
1993	Paice, Dennis	Monitoring of Breeding Success of Cliff-nesting Seabirds in Orkney, 1993	RSPB Office, paper
1997	Thompson, K.	Numbers and Breeding Success of Cliff-nesting Seabirds at Mainland Orkney Colonies in 1997	RSPB Office, paper
2000	Thompson, K. & Walsh, P.	Population trends and breeding success of cliff-nesting seabirds in Orkney, 1976 – 1998 [journal article]	RSPB Office, paper and PDF
2009	Paice, D.	Monitoring of Breeding Success of Cliff-nesting Seabirds in Orkney, 2009 [not the finished report]	RSPB Office Word doc only

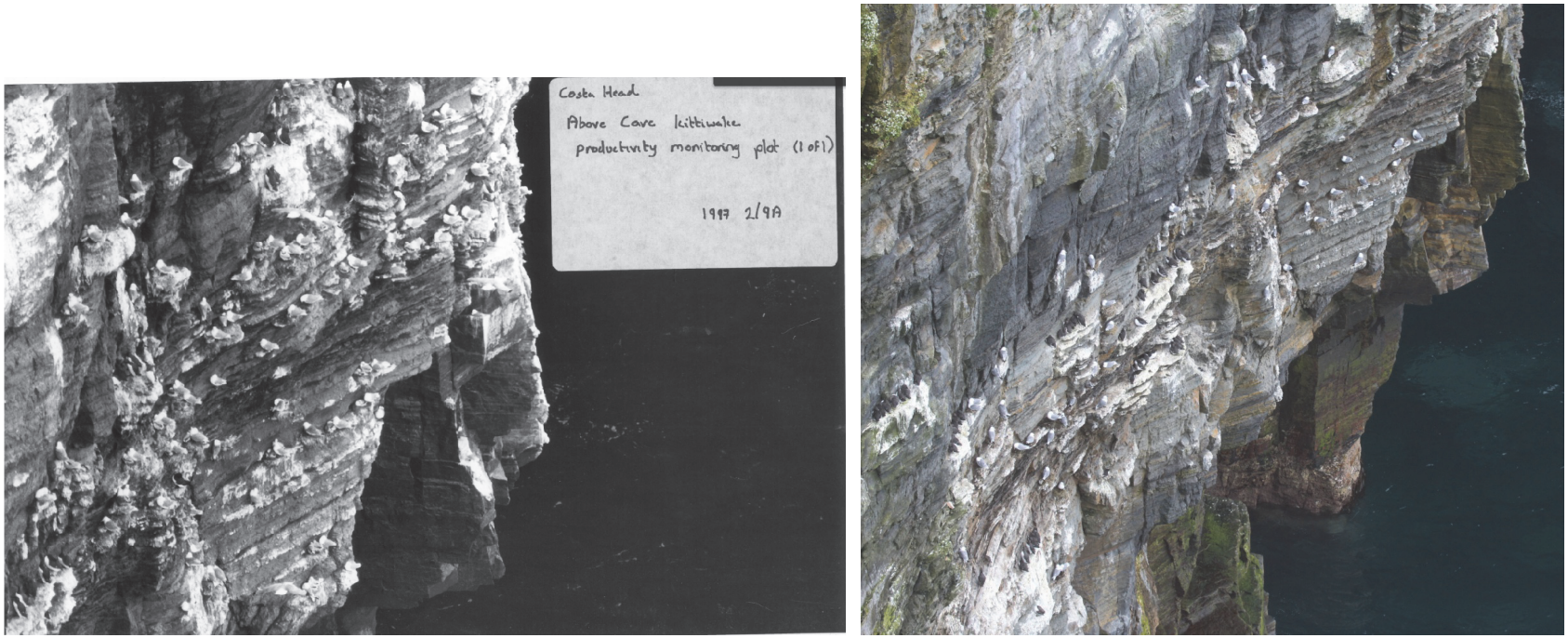
ANNEX 6: SUMMARY OF PLOTS AND SPECIES BY COLONY

Table 20. Summary of all colonies and plots with estimated transit and visit durations. Where transit time is the approximate walk-in time from car park to first plot.

Colony	Species	Plot	Visit Duration	Transit Time
Brough of Birsay	Kittiwake	East West	10-45 min	15 min
Costa Head	Fulmar	Ramna Geo Standard West	15-60 min	<30 min
	Kittiwake	Above Cave Main Face Ramna Geo Outer Left Ramna Geo Outer Right	10-45 min	20 min
Gultak	Fulmar	Geo Down Geo Up Main Cliff Second Geo	15-60 min	<30 min
	Kittiwake	New Plot 03	10-45 min	25 min
Marwick Head	Guillemot	Peedie Geo	90-120 min[1]	10 min
	Kittiwake	Monument Lower Monument Upper North End Lower North End Mid North End Upper Peedie Geo	10-45 min	15 min
	Razorbill	Peedie Geo	40-60 min	10 min
Mull Head	Fulmar	Brough Main Cliff Twisting Nevi Left Twisting Nevi Right White Fowl Nevi	15-60 min	30 min
	Guillemot	Mull Head 1 Mull Head 2	90-120 min[1]	30 min
	Razorbill	Twisting Nevi	40-60 min	35 min
	Shag	Facing Brough Twisting Nevi	<30 min	30 min
Row Head	Kittiwake	Blossom Yettna New	10-45 min	30 min

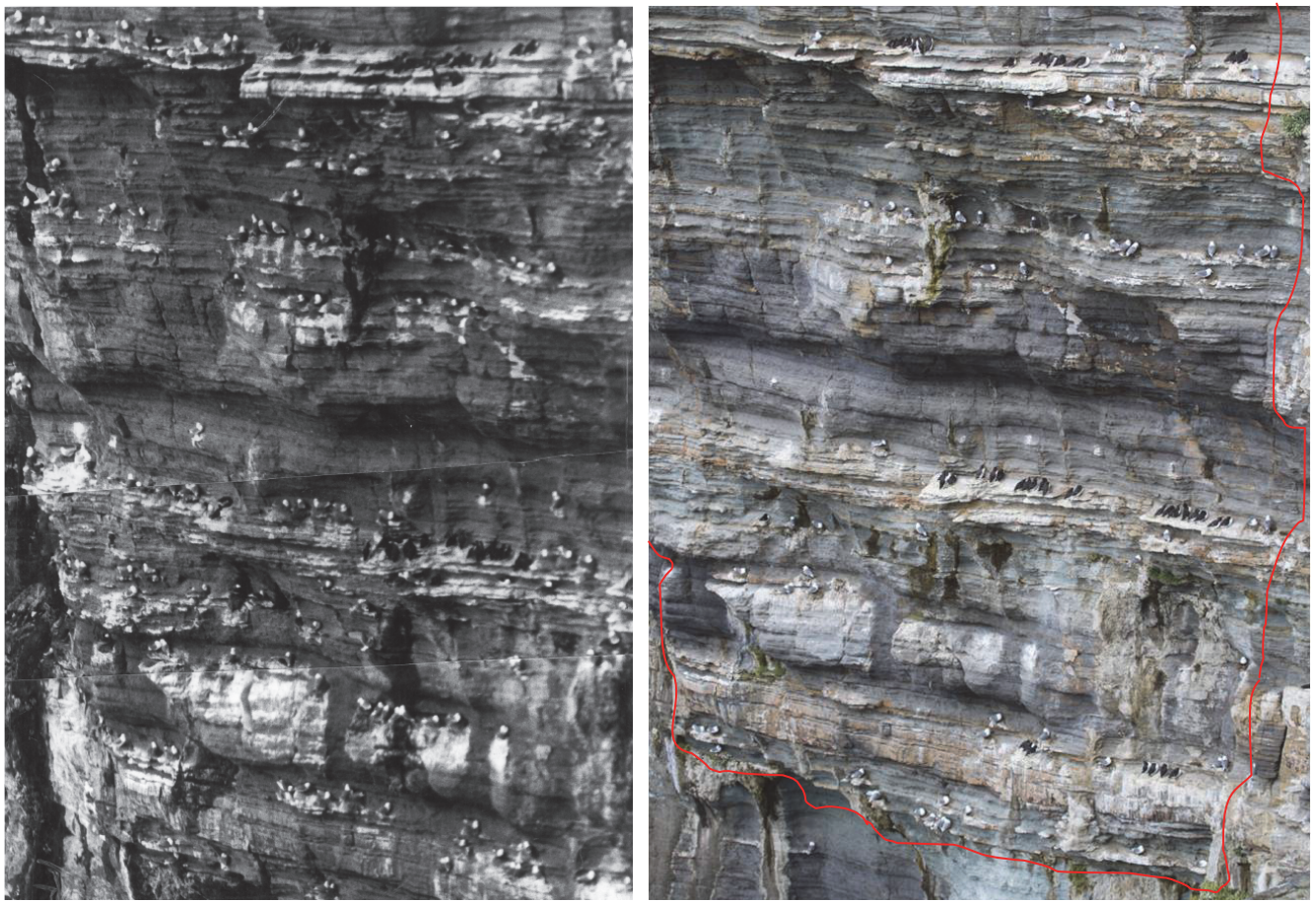
[1] Visit lengths decreased rapidly later in the season as so many pairs failed (but this would not apply in a more productive year).

ANNEX 7: KITTIWAKE PLOT EXTENSIONS AND NEW PLOTS

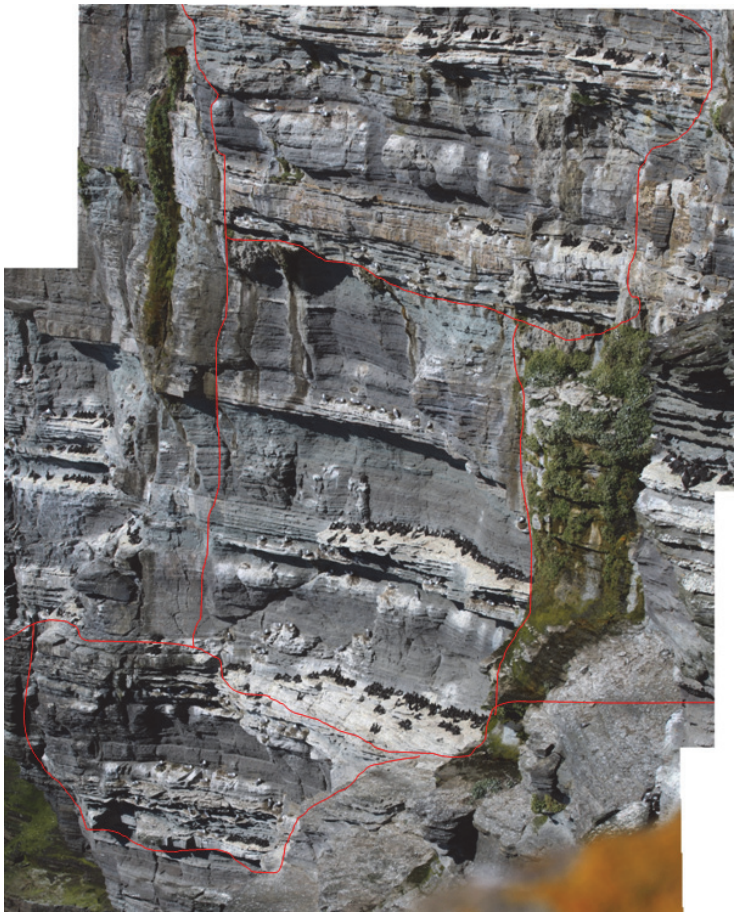


Costa Head “Above Cave” original Kittiwake plot on the left and new extended plot on the right.

Marwick Head “Monument Lower” original Kittiwake plot on the left, new extended plot on the right.



Marwick Head “North End” original kittiwake plot on the left and new extended plot, North End Upper, (within the red line) on the right.



Marwick Head North End new kittiwake plots: top section is bottom of “North End upper”, then “North End mid” in the middle and the last plot at the bottom is “North End lower”. (NB: these are not the working plot photos).


Brough of Birsay new Kittiwake plots allocated by Roddy Mavor (JNCC) in 2012: on the left is “West” and on the right is “East”

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Policy and Advice Directorate, Great Glen House,
Leachkin Road, Inverness IV3 8NW
T: 01463 725000

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