

**Breeding ecology and diet
of Great and Arctic skuas
on Handa Island 2008**



**Handa Island Skua Monitoring Programme
Final Report 2008**

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Photo and map credits

Cover page: Great skua chick with tormentil flower, by R. Green 2008
Figure 1 (page 6): Dark phase adult Arctic skua, by R. Green 2008
Maps and other figures (except where credited) by T. Jones, C. Smith & R. Green 2008

1. Summary

2008 saw the sixth full season of activities by the Handa Island Skua Monitoring Programme. Productivity of Handa's Great (*Stercorarius skua*) and Arctic skua (*S. parasiticus*) populations continued to be monitored following standard methodologies, and chicks ringed with standard BTO and Darvic colour rings. As in previous years productivity of Great skuas was monitored by focusing on a representative sample of pairs spread across 2 study sites, and the whole Arctic skua population was monitored. Great skua diet continued to be monitored by systematic sampling of regurgitated pellets from breeding pairs and club-sites.

Both the Arctic and Great skuas began breeding early in 2008, compared with previous years. The small Arctic skua population did not differ significantly from 2007, with 18 breeding pairs and 2 non-breeding pairs holding territory in 2008. The all-island survey of Great skuas was carried out on 2-3 June 2008, and recorded 260 AOTs; subsequent discoveries of more nests within our study sites raised this figure to 272 AOTs – a new record high for the island.

Great skua productivity was above the recent average, but remarkably similar to the previous year (for the first time in six years), with 0.77 chicks fledged per pair, compared with 0.76 in 2007. Interestingly however, productivity varied between the two study sites to a lesser degree than in previous years.

Among the 18 pairs of Arctic skua monitored, productivity remained low with only 0.22 chicks fledged per pair (compared with 0.23 in 2007). Of the four chicks which fledged, one was found predated. Cooperative defence against hunting Great skuas was observed again for the first time since 2004.

188 Great skua and 5 Arctic skua chicks were given BTO rings this year, while 63 Great skua and all Arctic skua chicks were also given a Darvic colour ring. Meanwhile, the long-term ringing programme initiated in 2003 is beginning to bear fruit. Great skuas colour-ringed as chicks in 2004 began to return to Handa this year, and others were spotted off the West coast of Ireland and on the Isle of Skye.

389 Great skua pellets were collected from 20 breeding territories, of which 43% were bird and 47% were fish. Of the 218 pellets collected from non-breeders at the club-site, 51% were bird and 37% were fish. A higher proportion of 'other' items such as rabbit and molluscs was recorded than in previous year. Overall however, composition of diet remained consistent with previous years, including an unchanged proportion of auk despite the guillemots' and razorbills' very poor breeding season.

Outputs

Rebecca Green of Anglia Ruskin University (Cambridge) conducted an undergraduate research project on diet and chick growth. Her detailed methods and findings will be presented in a separate report, as a poster at the forthcoming Seabird Group conference and an article in the February edition of the Seabird Group newsletter.

Summary breeding and dietary results, including maps, were provided for the annual Handa Warden's report, and an article in the Seabird Group Newsletter (Corton, 2008a,b). Census and productivity data are uploaded to the website of the JNCC Seabird Monitoring Programme (www.jncc.gov.uk/smp/default.aspx), and details of colour ringing are provided for the European Colour-ring Birding website (www.cr-birding.be).

In addition, the paper, "Jones T., Smith C., Williams E. & Ramsay A.: Breeding ecology and diet of Great *Stercorarius skua* and Arctic skuas *S. parasiticus* on the west coast of Scotland", which presents results from the 2003-2006 breeding seasons of both species, was published in the journal *Bird Study* in November 2008.

Previous reports of the Handa Island Skua Project are available for download at www.handaskuas.org

2. Methods

Trevor Jones and Claire Smith located and mapped Great skua territories from 30th May to 1st June, and conducted the all island survey on 2nd-3rd June; these activities were timed with reference to mean laydates determined from previous years' data (Smith & Jones, 2007; Jones *et al.*, 2008). Rebecca Green arrived on 6th June and after an intensive training period, continued the fieldwork until 13th August. Rebecca is a student at Anglia Ruskin University (ARU), Cambridge, and carried out her honours project on Great skua chick growth and diet (supervised by Dr. Nancy Harrison, ARU), as well as the regular monitoring of both skua species. Andrew Ramsay also visited at key times during the breeding season to assist with chick finding and ringing. Ngaio Richards completed the season from 11th to 21st August, monitoring late fledging pairs and sweeping Arctic skua territories to determine post-fledging mortality.

As in previous years, the all-island survey followed the standard methodology described in Walsh *et al.* (1995). Methods for locating and marking nests, monitoring productivity and Arctic skua post-fledging mortality were also consistent with previous seasons (Jones, 2003; Smith & Jones, 2004, 2005, 2006, 2007). This year, all breeding Arctic skuas (map, Appendix 2) and a sample of 86 Great skua pairs across the two established study sites (map, Appendix 1) were monitored. Breeding birds in Study Site 1 are consistently less productive than those in Study Site 2, which usually contains a smaller number of Greater-black backed gull (GGB) breeding territories. See Jones, 2003 for a detailed methodology, and Smith & Jones, 2004 for more detailed explanation of selection of study sites.

The length and breadth of all eggs were measured to the nearest 0.5mm using callipers, and egg volume calculated as $0.00048 \times \text{length} \times \text{breadth}^2$ (Coulson, 1963). Laydates were estimated for all nests of known hatching date, by subtracting the gestation periods of 29 and 25 days for Great and Arctic skuas respectively (Hamer, 2001; Phillips, 2001).

For monitoring diet in the Great skuas, regurgitated pellets were collected from 20 breeding territories (13 in Study Site 1, and 7 in Study Site 2), and from the main club site (non-breeding birds). Territories were cleared of pellets on 9th June and pellet collection began on 17th June, and was repeated every 7-10 days. Fish species found in pellets are currently being identified in the laboratory by examination of otoliths, with reference to an identification guide (Harkonen, 1986), and the results will be analysed as part of Rebecca's research project, and presented later.

The number of birds at Great and Arctic skua club-sites was counted opportunistically throughout the season.

3. Results

3.1 Population

3.1.1 Great skua

The all-island census was conducted on 2nd and 3rd June, and recorded 260 AOTs; subsequent discovery of more nests within our study sites increased the known total of AOTs to 272, the highest number on record.

Great skuas occupied only one club-site this year, in contrast to 2006-7 when two to three sites were used over the breeding season. The maximum club-site count was of 32 birds on 12th July.

3.1.2 Arctic skua

The first Arctic skuas returned to the island this year on 1st May 2008 (A. Corton, pers. comm.)

A total of 18 Arctic skua nests plus 2 apparently occupied territories (AOTs) were located on Handa this year, a slight decrease from 20 breeding pairs and 2 AOTs in 2007. There was no Arctic skua club-site this year.

This year 5 pairs of Arctic skuas recolonised an area south of the village (see map, Appendix 2) which had not held breeding pairs since 2004. The traditional Arctic skua stronghold (around Bothy Loch) contained only 3 breeding pairs, plus two AOTs. However, cooperative defence against Great skuas was observed in the stronghold and amongst the pairs south of the village.

Colour phases

Ten pairs of Arctic skua contained two dark phase adults, one pair contained two light phase, seven were mixed and colour phase was only determined for one bird for the remaining two pairs (Appendix 2).

3.2 Breeding Performance

Table 1. Breeding statistics of Great and Arctic skuas on Handa 2008. Sample sizes are in parentheses.

	Breeding pairs monitored	Mean lay date	Mean egg volume¹ (ml)	Mean clutch size	Hatching success (%)	Fledging success (%)	Chicks fledged² per pair
Great skua total	86	21 May (68)	81.6 (74)	1.89 (79)	92 (55)	49 (59)	0.77 (86)
Study Site 1	45	20 May (37)	82.3 (38)	1.87 (39)	86 (24)	54 (28)	0.71 (45)
Study Site 2	41	21 May (31)	80.9 (36)	1.95 (40)	97 (31)	46 (31)	0.83 (41)
Arctic skua	18	31 May (7)	44.1 (13)	1.72 (18)	39 (9)	33 (4)	0.22 (18)

¹ For Great skuas, we used the egg with the greatest volume (Furness, 1977); for Arctic skuas, we used the egg with the greatest volume, except where we observed which egg was laid first, in which case we used the α -egg (n=3)

² Great skuas were considered fledged if still alive after 40 days; Arctic skuas were considered fledged if still alive after 28 days

3.2.1 Great skua

Mortality factors

Hatching rate (92%) was high this year, with only five addled eggs observed, and a minimum of three eggs assumed predated, mostly near the breeding Great black-backed gulls in Study Site 1.

The majority of chick loss occurred before they were 10 days old, though some were lost after 10 days. Most are assumed predated, though a small number were found dead. Among these, one chick appeared to have died while hatching (while its sibling survived), and another chick was found dead at five weeks. In both cases there was no obvious cause of death observed.

Study Sites

Study Site 1 contained 4 Great black-backed gull (GBB) breeding pairs and was bordered by a further 3 pairs. By contrast, there was just 1 GBB pair breeding in Study Site 2, with 3 more pairs nearby.

Mean α -egg volume among Study Site 1 pairs was greater than in Study Site 2 (Table 1). However, mean clutch size was notably higher in Study Site 2 than in Study Site 1. Overall productivity in Study Site 2 was slightly higher than in Study Site 1.

3.2.3 Arctic skua

Five pairs are known to have failed at the egg stage, of which one pair had its egg predated by a Great black-backed gull, and one egg was addled. Nine pairs successfully hatched their eggs, and it is not known whether the eggs of the remaining four pairs hatched.

One chick was found dead prior to fledging. Four chicks fledged, of which one was later found predated.



Figure 1. Dark phase adult Arctic skua.

3.3 Diet of Great skuas

A total of 607 single item pellets (389 from territories and 218 from club-sites) were collected this year, and an additional 17 mixed pellets.

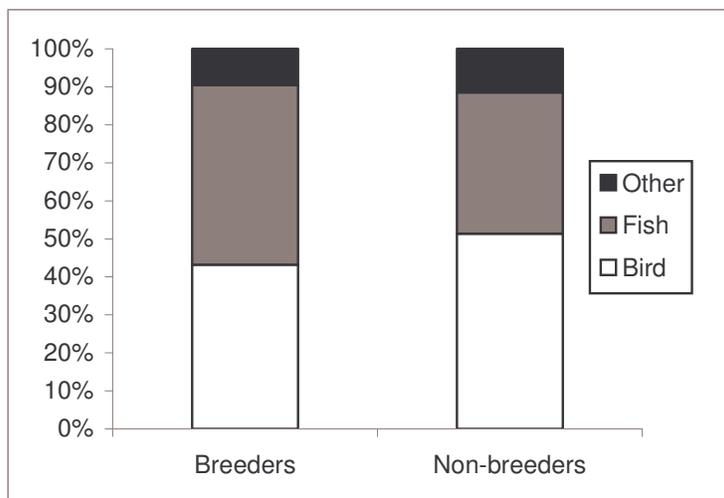


Figure 2. Percentage composition of food items in Great skua diet among breeders (on territory) and non-breeders (at club site). Based on single item pellets only (n=607).

As in previous years bird and fish pellets were fairly evenly represented on breeding territories (fig. 2, Table 2). Auk was the most consumed bird family, comprising about 30% of both breeders' and non-breeders' pellets. Gull species were the second most important food item. Storm-petrel (*Hydrobates pelagicus*) remains were found in three pellets. The skull of a Snipe (*Gallinago gallinago*) was also found, a previously unrecorded food item for Handa's Great skuas.

This year the category of 'other' food items comprised over 10% of all pellets, and contained rabbit (1% of breeders' pellets but not found in non-breeders'), common toad, shrew, crustaceans, crowberry, and other plant material.

Table 2. Proportions of food items found in Great skua pellets collected from 20 territories and club-site (breeders, n=389; non-breeders, n=218).

Food item	Breeders (%)	Non-breeders (%)
Fish	47.3	37.2
Bird	43.2	51.4
Other	9.5	11.4
Auk	29.6	28.4
Gull	11.8	18.4
Fulmar	1.5	3.2
Storm petrel	0.3	0.9
Snipe	0	0.5

4 Ringing

4.1 Rings deployed in 2008

A total of 188 Great skua and 5 Arctic skua chicks were ringed on Handa this year. All Arctic skua and 63 Great skua chicks were fitted with colour rings on the left leg (in addition to standard BTO rings on the right). The styles of Darvic colour rings fitted this year are shown below (fig. 3).



Figure 3. The style of Darvic rings deployed on (a) Arctic skuas and (b) Great skuas on Handa in 2008.

4.2 Re-sightings and recoveries

4.2.1 Great skua

Four birds colour-ringed as adults by Professor Bob Furness (University of Glasgow) between 1989 and 1991 were seen alive on the island in 2008, and the remains of 1 bird found dead. These birds were all at least 22 years old. Many birds were seen with BTO metal rings. Three were seen with white Darvic rings (probably ringed on Handa in 2004) and two with red Darvics (ringed on Handa in 2006 or 2007); these were all young birds returning to their natal colony for the first time.

In December a Great skua wearing a white Darvic ring was sighted off the west coast of Ireland. On 25th August 2008, another Great skua colour-ringed on Handa in 2004 (E8) was seen and photographed at Neist point on Skye by Bob Macmillan (fig. 4).



Figure 4. Great skua metal- and colour-ringed as a chick on Handa in 2004, and photographed on Skye in August 2008. Photo by Bob Macmillan.

4.2.2 Arctic skua

The light phase female Arctic skua ringed as a chick by Professor Furness in 1989, and known as Betty, did not return to her usual breeding site near the village this year, for the first time since we began monitoring in 2003. (In 2007 she bred as usual, when she was 18 years old.)

5 Discussion

5.1 Great skua population and breeding performance

In 2008 the Handa Great skua population reached a record high of 272 apparently occupied territories. Following colonisation of the island in 1964, the population steadily increased through the 1970s, 80s and 90s, before plateau-ing in the early 2000s (Jones *et al.*, 2008). The all-island survey was not carried out in 2007, but the 2008 figure represents a 35% increase in breeding pairs from the 2006 count of 202 AOTs. Similar population increases were also reported this year from some colonies in the Northern Isles (e.g. Fair Isle, increase of 31% from 2007) - though these surprising results are in the context of a long-term decline overall across Shetland and Orkney (see Seabird Group Newsletter, Vol. 109, October 2008).

Great skua productivity, at 0.77 chicks fledged per pair, was the second highest since current monitoring began in 2003 (Smith & Jones, 2007; Jones *et al.*, 2008) and for the first time was remarkably consistent with the previous year (0.76 in 2007). Only 2004 was a more productive year with 0.88 chicks per pair. The number of chicks ringed outside the study sites was also a record high suggesting that productivity was high across the whole colony.

In fact, this excellent year for the Great skuas is reflected in all the breeding parameters being higher than the long-term means, including mean egg volume, mean clutch size, hatching and fledging success (Jones *et al.*, 2008). Most parameters were however remarkably consistent with those known from 2007 - which was the first 'good year' since 2004 - with one exception: mean clutch size continued to rise to a very high mean of 1.89, compared with the 2003-6 mean of 1.73, and a mean of 1.85 in 2007.

Laying among Great skuas occurred particularly early in 2008, with a mean lay date of 21 May, compared with the 4-year mean from 2003-2006 of May 26 (range May 24-May 29). Early laying was also observed in the Arctic skua colony (see below).

Productivity in Study Site 2 was slightly higher than in Study Site 1 - though to a lesser degree than in previous years. Indeed productivity in Study Site 1 was the highest on record, a significant contributing factor to the overall breeding results for the season. In previous years we have suspected that the consistently low productivity in Study Site 1 is due to predation, in particular by Great black-backed gulls (e.g. Smith & Jones, 2004). Whether this year's relative success can be attributed to a recent decline in breeding GBBs on the island, or to other factors such as Great skuas adapting to the threats posed by these predators, may provide an interesting topic for future research.

The observations in 2008 of young birds ringed on Handa in recent years beginning to return to the island, is an encouraging sign for the future of the colony.

5.2 Arctic skua breeding performance

Arctic skuas had another poor year - though fairly consistent with 2007. The decline in breeding population observed in the early 2000s appears to have been arrested for now: there were 20 AOTs recorded in 2008, compared with 20 in 2007 and 17 in 2006.

Chicks fledged per pair remained low (mean of 0.22), with predation of eggs and chicks (both pre- and post-fledging), primarily by Great skuas, once again major contributing factors. It was interesting to observe some cooperative defence by Arctic skua parents against hunting Great skuas - for the first time since 2004. However, how long the colony can continue when producing only 3 or 4 chicks per year remains to be seen.

Like the Great skuas, the Arctic skuas laid early this year (mean lay date 31 May, compared with 2003-6 mean of 8 June, range 3-12 June).

5.3 Great skua diet

Pellet collection began later than usual this year (especially given this year's early mean lay dates), which may partially explain the fewer number of pellets collected from territories than in recent years.

In general, composition of diet was fairly consistent with 2007, and with the longer-term picture since 2003 (Smith & Jones, 2007; Jones et al., 2008), with a couple of noteworthy differences. Just over half the pellets found on the club site were bird (51.4%), a lower proportion than in previous years, with fish pellets just over a third (37.2%). Pellets of breeding birds were more evenly split, as usual, between bird (43.2%) and fish (47.3%).

Snipe, which breed in high density across the island, including among Great skua breeding territories, was a new prey item recorded for the first time this year. The collection of three pellets containing Storm petrels is also of interest, considering the nocturnal habits of this species.

The proportion of pellets comprising 'other' food remains, including rabbit, beetle, molluscs, bivalves and plant material, was higher than usual this year (over 10%, compared with about 5% in 2007 and between 2% and 7% in previous years).

Perhaps surprisingly, considering the decline in abundance and breeding success of guillemots and razorbills at the cliffs in recent years (Klein, 2007; Corton, 2008), the proportion of auk found in Great skua pellets has not changed significantly. Indeed our results have been fairly consistent since we began monitoring pellets in 2004, especially among breeders, where auk have comprised 20-30% of all pellets analysed each year.

6 Workplan 2009

Recruitment of an undergraduate student in 2008 to carry out the majority of the annual skua monitoring, as well as her own research project, was adjudged a great success - and we therefore propose to follow the same model next year. We thus propose that our student (to be recruited in early 2009) be based on the island constantly from early June until mid-late August of the 2009 season. S/he will again be trained by T. Jones at the beginning of June, and further supported on occasional visits throughout the season by C. Smith, A. Ramsay and other volunteers from the Highland Ringing Group. Claire Smith will also make the first visit to the island at the end of May to establish the study sites. In this way, we aim to sustain the same level of intensive monitoring of Handa's skua populations achieved in 2008, and to complete another original research project.

In summary, we plan the following fieldwork on the island in 2009:

Date	Data collected	Fieldworker(s)
27-30 May	Great skua nests, mapping, egg volumes & clutch size	CS +1
6-15 June	Great and Arctic skua nests, mapping, egg volumes & clutch size; all-island survey; training of student	TJ & Student
10 June – 25 Aug	Great skua chicks, Arctic skua nests and chicks, Great skua pellets, ringing, fledglings and post-fledging mortality; original research project	Student ¹

¹with support from A. Ramsay and Highland Ringing Group

7 Funding

In 2008, the Handa Island Skua Project received small grants from The Seabird Group (£600) and the Scottish Ornithologists Club (£550), and continued in-kind support from the Scottish Wildlife Trust. In addition, Rebecca Green has been awarded £250 by Anglia Ruskin University towards attending the International Seabird Group Conference in March 2009, where she will present results from the 2008 field season.

Fundraising efforts for the 2009 field season are under way.

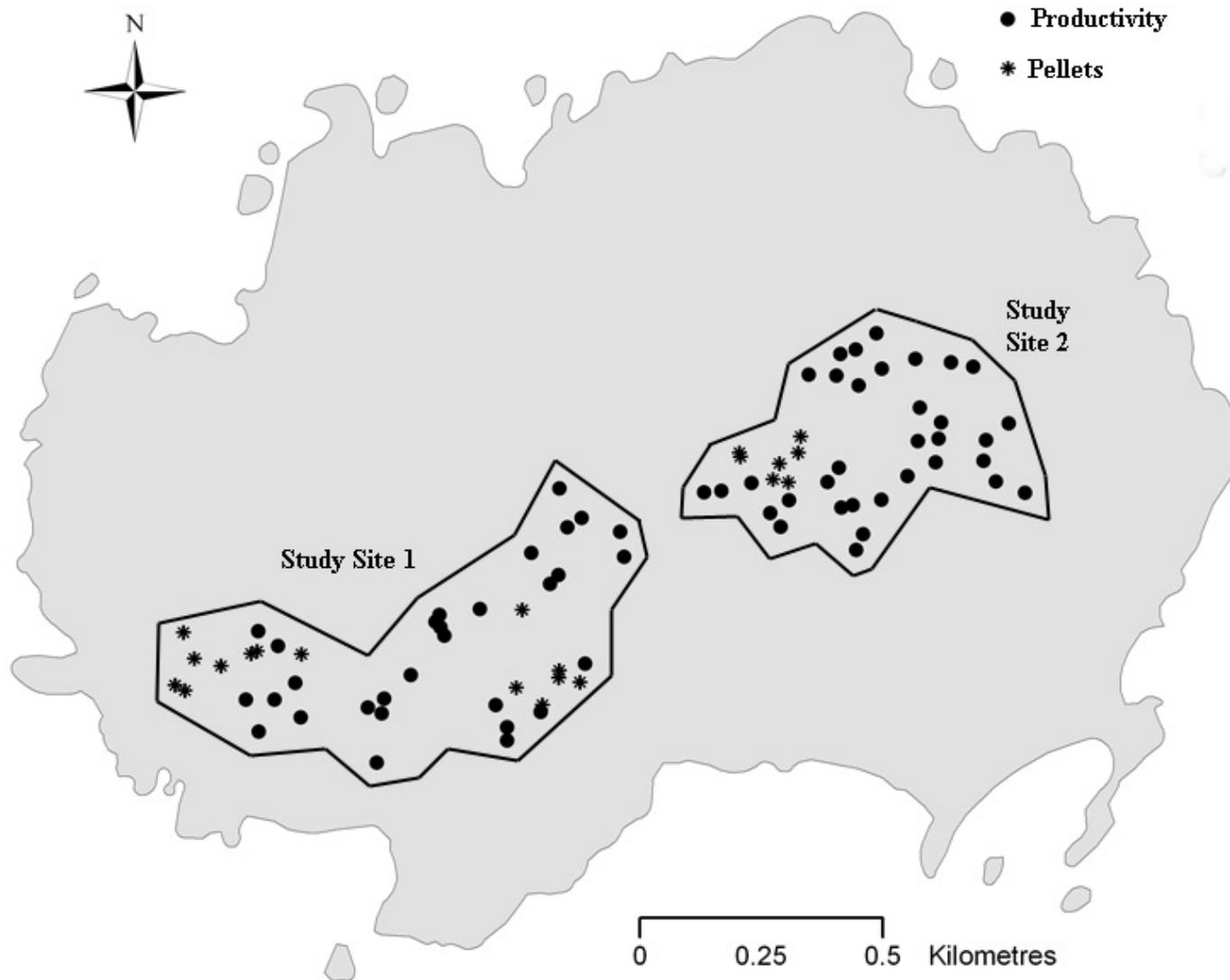
8 Acknowledgements

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9 References

- Caldow, R.W.G. & Furness, R.W. (2000) The effect of food availability on the foraging behaviour of breeding Great skuas *Catharacta skua* and Arctic skuas *Stercorarius parasiticus*. *Journal of Avian Biology* 31: 367-375.
- Corton, A. (2008a) *Handa Island Nature Reserve Warden's Annual Report 2008*. Scottish Wildlife Trust, Edinburgh.
- Corton, A. (2008b) 2008 Breeding Season News: Handa Island. *Seabird Group Newsletter* 109: 11-12.
- Coulson, J.C. (1963) Egg size and shape in the Kittiwake (*Rissa tridactyla*) and their use in estimating age composition of populations. *Proceedings of the Zoological Society of London*. 140: 211-227.
- Furness, R.W. (1983) Variations in size and growth of Great Skua *Catharacta Skua* chicks in relation to adult age, egg volume, brood size and hatching sequence. *Journal of Zoology London*. 199: 101-116.
- Hamer, K.C. (2001) *Catharacta Skua* Great Skua. *BWP Update* Vol. 3 No. 2
- Harkonen, T. (1986) Guide to the Otoliths of the bony fishes of the North East Atlantic. Danibu Aps, Biological Consultants.
- Jones, T. (2003) *The breeding ecology of Great and Arctic skuas on Handa Island 2003*. Unpublished report to SWT, SNH, JNCC, The Seabird Group.
- Jones, T., Smith, C., Williams, E. & Ramsay, A. (2008) Breeding ecology and diet of Great *Stercorarius skua* and Arctic skuas *S. parasiticus* on the west coast of Scotland. *Bird Study* 55: 257-266.
- Klein, D. (2007) *Handa Island Nature Reserve Warden's Annual Report 2007*. Scottish Wildlife Trust, Edinburgh.
- Phillips, R. (2001) *Stercorarius parasiticus* Arctic skua. *BWP Update* Vol. 3 No.1 25-41.
- Smith, C & Jones, T. (2004) *Handa Island Great and Arctic Skua Monitoring Programme Final Report 2004*. Unpublished report to SWT, SNH, JNCC, The Seabird Group.
- Smith, C & Jones, T. (2005) *Handa Island Great and Arctic Skua Monitoring Programme Final Report 2005*. Unpublished report to SWT, SNH, JNCC, The Seabird Group.
- Smith, C & Jones, T. (2006) *Handa Island Great and Arctic Skua Monitoring Programme Final Report 2006*. Unpublished report to SWT, SNH, JNCC, The Seabird Group.
- Smith, C & Jones, T. (2007) *Handa Island Skua Monitoring Programme Final Report 2007*. Unpublished report to SWT, SNH, JNCC, The Seabird Group.
- Votier, S.C., Bearhop, S. Ratcliffe, N & Furness, R.W. (2001) Pellets as indicators of diet in Great skuas *Catharacta skua*. *Bird Study* 48: 373-376.
- Walsh, P.M., Halley, D.J., Harris, M.P., del Nevo, A., Sim, I.M.W. & Tasker, M.L. (1995) Arctic skua *Stercorarius parasiticus*/Great Skua *S. Skua*. *Seabird monitoring handbook for Britain and Ireland*. JNCC/RSPB/ITE/Seabird Group, Peterborough.

Appendix 1: Map of Great skua study nests 2008, showing study sites and territories monitored for productivity and diet. (Nests monitored for diet were also monitored for productivity).



Appendix 2: Map of all Arctic skua nests 2008, showing colour phases of breeding birds.

