



Population status and trends of Southern Giant Petrels (*Macronectes giganteus*) in the Falkland Islands

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Summary

A survey of key breeding sites of Southern Giant Petrels (*Macronectes giganteus*) within the Falkland Islands was undertaken in 2015/16. The minimum breeding population of the Islands was estimated to be 20,970 ± 180 pairs, an increase of 7.4 % since the previous census in 2004/05. Sixteen breeding sites were confirmed, supporting a minimum of 21 colonies/breeding areas; however, this figure does not account for likely additional small groups or single pairs breeding around the coasts, which were not surveyed. Based on the previous census, these small groups (constituting less than 0.5 % of the total estimated figure in 2004/05) are unlikely to significantly influence the overall population estimate. The current Falkland estimate would increase the global population estimate by 1441 breeding pairs to 48,239 breeding pairs; of which the Falklands would comprise approximately 43 %.

Of the ten key breeding sites (Key Sites) for this species at the Falklands, five had decreased, four had increased (one based on a partial count) and one remained only partially surveyed. Changes in breeding pairs at colonies ranged from a reduction of 754 pairs to an increase of 1554 pairs. Percentage change at colonies ranged between a reduction of 100 % (i.e. no colony now present), to an increase of 245 %. Average change over the eight Key Sites with complete counts was an increase by 1.6 % ± 65.3 %. The total count for sites other than Key Sites had increased by 744 pairs (57 %) since the 2004/05 census.

Major threats remain to be human disturbance and fisheries by-catch, both within the Falklands EEZ, but likely more significantly beyond it. Uncertainties around other threats, such as climatic changes/El Niño and increasing evidence of plastic ingestion in seabirds remain unknown for this species in the Islands. Population monitoring through two Island surveys (2004/05 and 2015/16), as well as annual monitoring since 2006, point towards a stable, but likely increasing breeding population of Southern Giant Petrels in the Falkland Islands.

Introduction

Global Status and Threats

The Southern Giant Petrel (SGP) has a circumpolar distribution with a breeding range from c. 40°S (Gough Island) to c. 68°S in West Antarctica. Colonies occur on oceanic islands or island groups off South America, Antarctica, and in sub-polar regions (ACAP 2010). The estimate for the global population is 46,800 (BirdLife 2016) pairs, with an unpublished report estimating c. 54,000 breeding pairs (however, this is in the absence of comprehensive recent data (less than 10 years old) from the Antarctic breeding sites (BirdLife 2016)).

There are relatively few published data on the species and regular count data are rare. There is little useful information on populations prior to 1966 as Southern and Northern Giant Petrel were still considered a single species (Bourne and Warham 1966). Many published counts are now over ten years old (Quintana et al. 2006, Reid and Huin 2008; Gonzalez Solis and Croxall 2005) with few more recent than 2008 (Patterson et al. 2008; Lynch et al. 2008). Varying approaches to count methodologies, including differing count units, sub-sampling and timing hinder comparisons (Patterson et al. 2008) and breeding 'sabbaticals' (Voisin 1988) may influence interpretation of even the more rigorous counts. Consequently, long-term data sets, rather than snap shot censuses may provide a more reliable indication of trends (Creuwels 2005).

Globally, population trends appear to vary considerably across colonies (BirdLife 2016); however, previous surveys of the two largest populations in the Falkland Islands (Reid and Huin 2008) and South Georgia (Poncet et al. in litt. 2008) indicate increases. Combining trend data has provided a best estimate of a 17 % increase and a worst-case scenario of a 7.2 % decline over the past three generations (64 years) (BirdLife 2016). These positive trend indications led to the down-listing on the IUCN RedList from 'Vulnerable' to 'Near Threatened' in 2007 and then in 2009 to 'Least Concern'.

The species is listed under the Convention on Migratory Species - Appendix II and the Agreement on the Conservation of Albatrosses and Petrels - Annex 1.

Southern Giant Petrel is considered primarily a scavenger taking carrion at seabird colonies and discards from fishing vessels; however, it also takes a range of natural food sources (Copello et al. 2008), predated cast sheep (Cawkell and Hamilton 1961) and feeds at sewage outfalls (Woods and Woods 1997). It ranges widely, making circumpolar trips as a juvenile (Trivelpiece and Trivelpiece 1998), but also as adults from breeding colonies where females have a tendency to forage more pelagically than males (Hunter and Brooke 1992).

The species' breeding and feeding ecology expose it to a number of threats including plastic ingestion (Copello et al. 2008), pollution (Luke et al. 1989), human disturbance/tourism (Warham 1962; Chupin 1997, Pfeiffer and Peter 2004), oiling (Petty and Fonesca 2002), and fisheries by-catch (Favero et al. 2003).

Falklands Islands Status and Threats

In 1982 the Falkland Islands population was estimated at 3,200 pairs (Croxall et al. 1984) rising to 5 – 10,000 pairs between 1983 and 1992 (Woods and Woods 1997). The first dedicated Island survey conducted in 2004/05 estimated the Falkland Islands population at 19,529 breeding pairs, or about 40 % of the global estimate (Reid and Huin 2008).

Woods (1975) suggests that the population of Southern Giant Petrels increased in the 19th and 20th centuries but declined in the mid-part of the 20th century due to persecution associated with sheep farming; however, Cawkell and Hamilton (1961) also report extensive egg collection between 1950 and 1954 - a practice that probably occurred over a longer timescale and is likely to have had more wide-reaching effects. The species continues to be impacted by fisheries (Kuepfer 2016), with mortality of 'Giant Petrel' recorded during the last 11 years in trawl fisheries (records have not always been species specific; however, whilst Northern Giant Petrels (*Macronectes halli*) are recorded in Falkland Island waters, it is predominantly Southern Giant Petrel that occurs). Annual mortality estimates from trawler fisheries before the introduction of by-catch mitigation methods (2002-2003) were of 98 birds, whilst annual estimates since introduction of by-catch mitigation have varied between 0 and 64 with a mean of 25 (Falkland Islands Government Fisheries Department, pers. comm.).

The species is recognised in Falkland Islands policy and legislation:

- Conservation of Wildlife and Nature Ordinance 1999;
- Fisheries (Conservation and Management) Ordinance 2005;
- Falkland Islands FAO. National Plan of Action for Reducing Incidental Catch of Seabirds in Longline Fisheries. Falkland Islands Government. Stanley, Falkland Islands; and
- Falkland Islands national plan of action for reducing incidental catch of seabirds in trawl fisheries. Falklands Conservation (Sancho 2009).
- Falkland Islands implementation plan for the Agreement on the Conservation of Albatrosses and Petrels (ACAP): review of current work and a prioritised work programme for the future. Falkland Islands Government. Stanley, Falkland Islands (Wolfaardt et al. 2013).

This survey work contributes to the achievement of Action 5.2.5 within the above prioritised work programme.

Methods

Previous

In the previous survey of Southern Giant Petrels (SGP) in 2004/05, potential colony locations for survey were informed by database records and landowner discussions (Reid and Huin 2008). Counts of incubating adults (during November/December 2004) and chicks (during January/March 2005) were made at colonies using site visits and aerial photographs. At a sub-sample of sites, counts were made of both incubating adults and chicks. These estimates were used to calculate mean breeding success, which was in turn used to back-calculate pair estimates from locations where only chick counts had been possible.

Reid and Huin (2008) applied a number of counting principles:

- All SGP sitting below the high water mark were discarded as non-breeding individuals;
- Standing adults or those not on an obvious nest were not included in the counts;
- Counts were redone until within 5 to 10 % of each other;
- Both adults present by a nest were counted as one pair.

Current

Survey Sites

The approach taken in the current study was, wherever possible, to follow the survey principles of the 2004/05 census so that results would be comparable. However, the aim of the current study was to survey 'Key Sites' (rather than *all* sites within the Islands), based on the previous survey (Reid and Huin 2008) which reported 97.6 % of the Falkland Island population at ten locations (*Table 1*). In addition, during the current study further breeding pair estimates were gathered from landowners where possible.

Reid and Huin (2008) identified 38 breeding locations; however, 'location' is difficult to define, in some instances being applied to count areas, on other occasions to whole islands which have a number of areas whence counts were obtained. Inconsistencies in defining locations/colonies is inevitable with SGP, as they breed in dense colonial groups or scattered as individuals along coastlines. To facilitate comparisons the same 'Sites' are used as in Reid and Huin (2008).

Site	Percentage of total Falkland Islands population (estimated breeding pairs in brackets)
Steeple Jason	7.3 (1,440)
Grand Jason	4.1 (820)
Governor Island	3.6 (723)
Barren Island	8.2 (1,619)
George Island	3.3 (647)
Bleaker Island	0.9 (188)
Penn Island	7.8 (1,543)
Third Passage	2.0 (405)
Golden Knob	5.1 (1,019)
Sandy Cay	55.2 (10,936)

Table 1. Key Sites for breeding Southern Giant Petrel in the Falkland Islands with percentage contribution to the overall population estimate from 2004/05.

Access to sites (for land-based survey) and availability of aerial survey platforms are significant constraints in the Falkland Islands. Consequently, in order to be able to undertake the survey during the 2015/16 season, photographs were obtained opportunistically by military personnel during standard flying operations. Photographs of sites were taken on 2 December 2015 during incubation, during incubation/chick rearing on 7 January 2016 and during chick rearing on 2 February 2016. Photography was targeted at previous count locations from the 2004/05 census, which had been identified on flight maps.

High resolution images were taken from over 650 m altitude, to avoid disturbance, using a Canon EOS 5D Mark III with telephoto lens. The work was conducted under Falkland Islands Government Research Licence R14/2015.

Sites for which estimates were obtained are shown in [Figure 1](#).

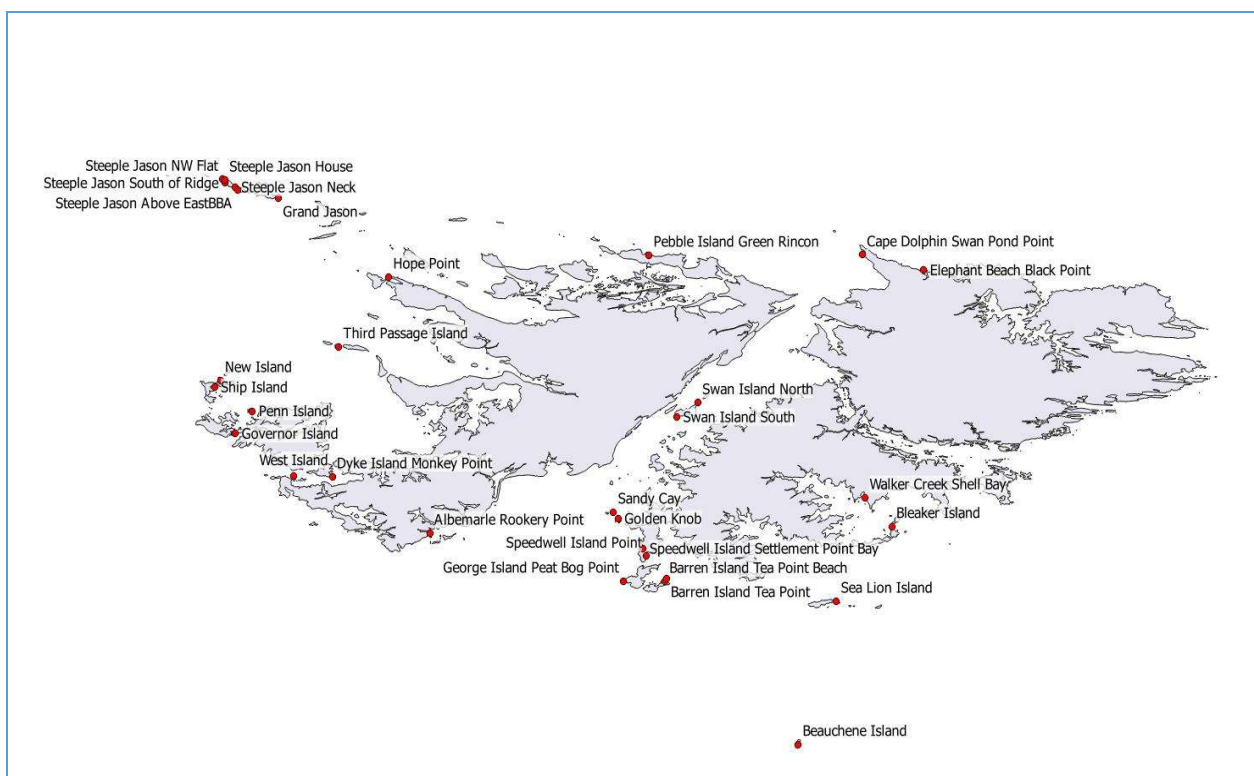


Figure 1. Sites for which Southern Giant Petrel breeding pair estimates were obtained during the 2015/16 survey.

Estimated Counts

Site photographs were counted in entirety, or split into count areas, either to facilitate counting or to allow for larger colonies split over multiple images. Groups of birds (adults or chicks) were counted at least twice, by two different counters using ImageJ software. Photograph examples are provided in [Figure 2 and 3](#).

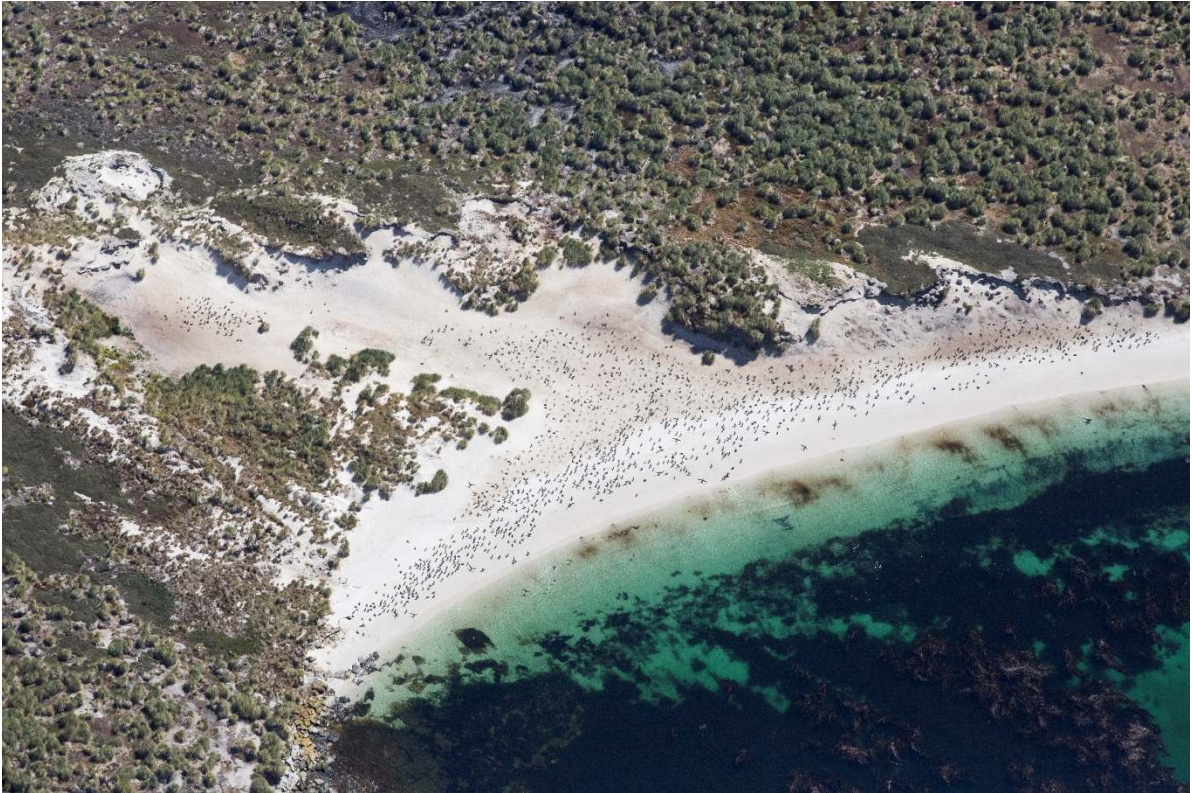


Figure 2. Southern Giant Petrel colony on Penn Island, taken 12 February 2016.



Figure 3. Southern Giant Petrel colony on Penn Island, taken 12 February 2016, zoomed image showing chicks.

All counts for each colony or count area were used to derive an estimated mean and standard deviation for either Apparently Occupied Nests (AON), or Pre-Fledged Chicks (PFC). Due to the high susceptibility to disturbance of this species in the Falkland Islands, it was not possible to refine the count from those birds that were apparently breeding

(AON) to those that were actually breeding (Breeding Pairs). As for the 2004/05 census the AON was used to represent the breeding pair count. Small chicks were evident in some of the 7 January 2016 photos (used for Governor and Third Passage Islands estimates only); however, due to the high proportion of incubating adults, these counts are considered within counts of AON.

The Falkland Islands Seabird Monitoring Programme (FISMP) is an annual monitoring programme that provides estimates of breeding pairs and breeding success for a number of seabird species in the Falkland Islands (Crofts and Stanworth 2016). One breeding colony of SGP at Steeple Jason has been monitored annually since 2006. A further site, Bleaker Island, has been monitored by the landowner since 2001 and is reported through the FISMP. Counts at Steeple Jason are field counts by paired observers of AON and PFC. Counts at Bleaker Island are of PFC. Both FISMP counts from 2015/16 were incorporated into the survey.

The breeding pair estimate and breeding success estimate for Ship Island and New Island were from D. Gianuca and P. Catry (pers. com.). Beauchêne Island breeding pair count was from P. Catry (pers. com.).

For Sandy Cay the main part of the colony was photographed on 7 December 2015; however, a sub-colony to the immediate south was only photographed on 2 February 2016. For this sub-colony, breeding success from the Sandy Cay main colony (estimated by sub-sample) was used in conjunction with the PFC estimate to back-calculate an estimate for breeding pairs. This was done on the assumption that the breeding success at the adjacent larger colony would be more representative of that for the sub-colony than the average from a number of sites across the Islands.

For other sites where no, or only partial, AON data was available, breeding success from other sites was used to estimate the number of breeding pairs from the estimated number of PFC. In total, the estimated breeding success was calculated at six sites, based on estimated AON and PFC counts. Two of these sites were evaluated under the FISMP. Due to differences in count dates, these were not used to derive a mean breeding success for the survey. The mean breeding success was therefore derived from four sites, namely Penn, Third Passage, Sandy Cay and Ship Island. This value was applied to the February PFC estimates to derive a breeding pair estimate.

Results

Counts

Complete breeding pair estimates (based on AON) were obtained for eight of the ten Key Sites from the 2004/05 census and a further fourteen complete estimates for other locations were collated ([Appendix 1](#)). Two Key Sites (Barren and George Islands) were not fully re-surveyed due to a combination of logistical constraints, incomplete coverage during flights or image quality. As such, the counts are likely to represent a minimum value for these locations. Counts are expressed as a Mean \pm one Standard Deviation.

New areas within existing 'Sites' were found at Steeple Jason (NW Flat), Speedwell Island (between Tank and Annie Point, and by Settlement Point Bay), and George Island (Speedwell Pass). Ship Island and Walker Creek (Shell Creek) were new 'sites'. New Island does not represent a newly established colony, but was not counted in the previous census.

The estimated minimum number of breeding pairs from the current survey was 20,970 \pm 180 breeding pairs across those sites shown in [Figure 4](#).

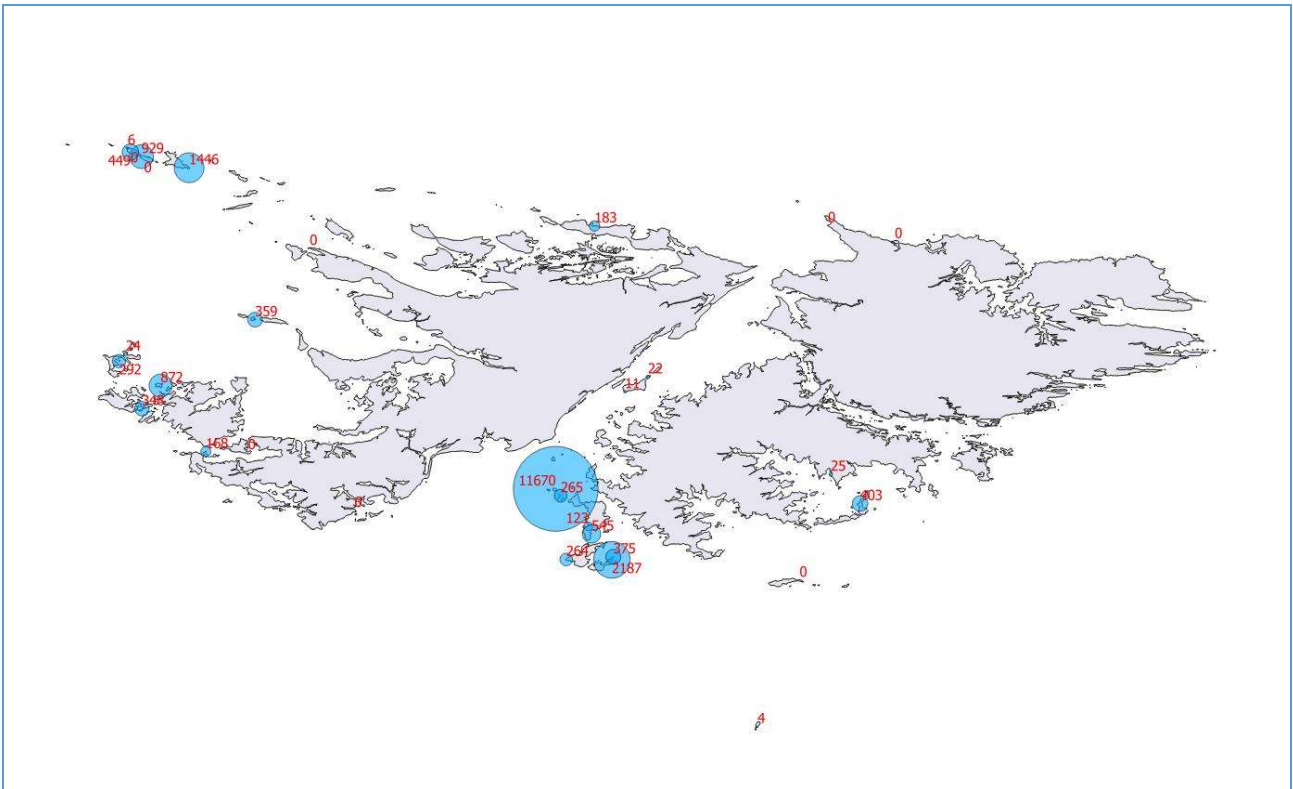


Figure 4. Southern Giant Petrel breeding pair estimates for sites surveyed in 2015/16. Blue circle areas relate to the size of the estimate.

The total represents an increase of 1441 breeding pairs or 7.4 % since the previous survey in 2004/05. Of the ten Key Sites, five were found to have decreased estimates, four increased estimates (the Barren Island count had increased beyond previous estimates even though the count during the current study was incomplete); there was no current estimate for George Island.

Site changes in breeding pairs range from a reduction of 754 pairs to an increase of 1554 pairs. Percentage change ranged between a reduction of 100 % (i.e. no colony now

present), to an increase of 245 %. Average change over the eight complete counts was of an increase by $1.6 \% \pm 65.3 \%$. This high Standard Deviation precludes any statistical significance to this across-sites 'increase'. The total count for sites other than Key Sites had increased by 744 pairs or 57 %. Changes are illustrated in [Figure 5](#).

The ten Key Sites represent 97.5 % of the estimated breeding pairs for the Falklands, and of this 71.8 % is represented within a group of offshore islands at the south of Falkland Sound, including the largest single site Sandy Cay (55.2 %). Steeple and Grand Jason represent the second largest aggregation (11.4 %) of breeding pairs. Breeding sites for this species are predominately found on offshore islands with a marked absence from the mainland West and East Falklands.

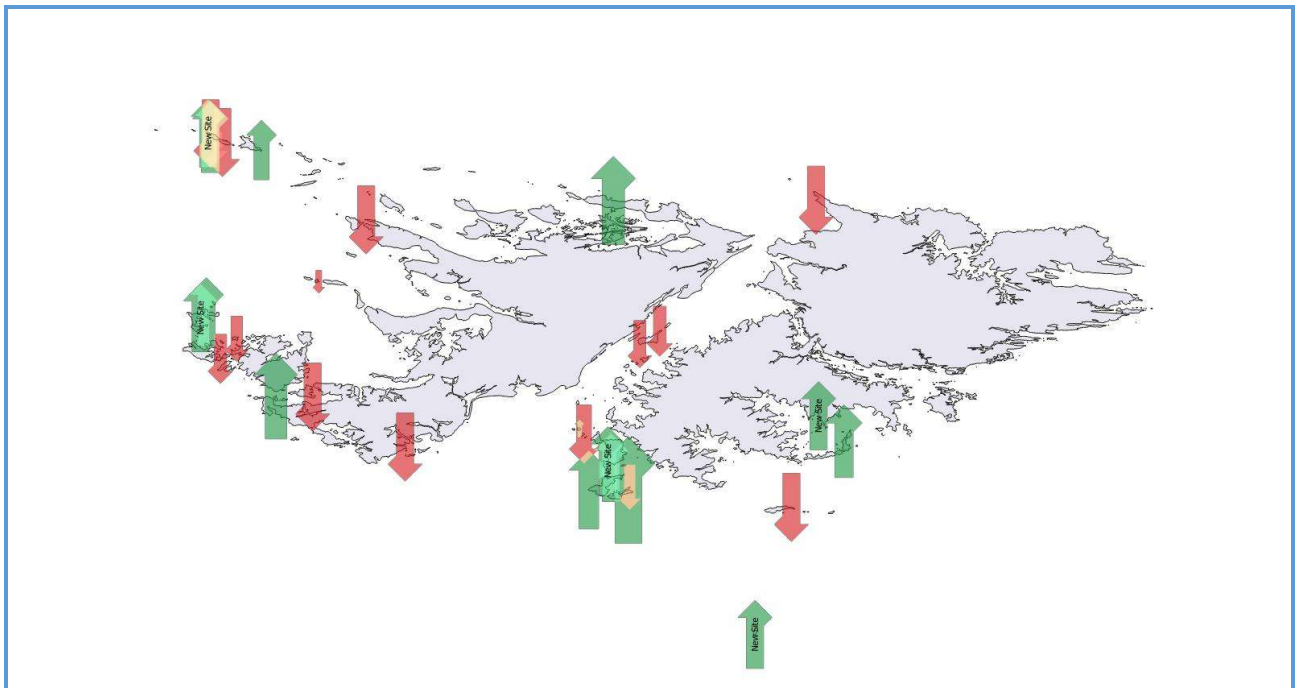


Figure 5. Changes in breeding pair estimates of Southern Giant Petrel between 2004/05 and 2015/16 surveys. Green arrows represent an increase, red arrows a decrease. Arrow size relates to the magnitude of the change.

Counts at breeding sites ranged from one or two individuals to $11,670 \pm 54$ pairs. At Sandy Cay the majority of the birds was in a very large colonial group, whereas at other sites the 'colony' could be a combination of several distinct sub-colonies dispersed over an area and separated by several hundred metres (e.g. Steeple Jason and Grand Jason), or indistinct, broadly-associated individuals or small numbers of birds over a wide area (e.g. Steeple Jason South of Ridge).

Habitat

Breeding sites were predominantly located on offshore islands, and all were located coastally, often close to the high water mark. The majority were associated with bare/eroded flat ground (comprising thin soils, clay or rocks) with the remaining colonies on sand ([Table 2](#)).

Site	Substrate
Barren Island - Tea Point Beach	Sand
Barren Island - Tea Point	Bare Ground
George Island – Peat Bog Point	Bare Ground
Golden Knob Island	Sand
Governor Island	Bare Ground
Grand Jason	Bare Ground
Penn Island	Sand/Bare Ground
Sandy Cay Island	Sand
Speedwell Island – Between Tank and Annie Point	Sand
Speedwell Island – Settlement Point	Sand
Steeple Jason	Bare Ground
Swan Island – North and South	Bare Ground
Third Passage Island	Bare Ground
West Island	Bare Ground

Table 2. Substrates at Southern Giant Petrel breeding sites in the Falkland Islands from 2015/16 survey.

Most sites remained similar in underlying substrate between the 2004/05 and 2015/16 surveys; however, there was a notable change at Golden Knob on the north side of the colony. In the 11-year interval between surveys there had been considerable growth of tussac grass (*Poa flabellata*) into the previously occupied breeding area, associated with a major reduction in the number of breeding pairs (*Figure 6 and 7*).



Figure 6. Golden Knob, showing Southern Giant Petrel breeding area on north side in 2004/05 census.



Figure 7. Golden Knob, showing Southern Giant Petrel breeding area on north side in 2015/16 census.

Discussion

Breeding Pair Estimate

The current study provides a minimum estimated breeding population of Southern Giant Petrels in the Falkland Islands of $20,970 \pm 180$ breeding pairs. This is a higher estimate, by 7.4 %, than provided by the census in 2004/05 (Reid and Huin 2008) and strong indication that there is currently no long-term decline in the Falkland Islands population. Whether the survey result provides support for an increasing population, needs to be considered in the context of a number points:

Breeding Ecology

There is evidence that breeding activities in SGP are interspersed with “sabbatical” periods i.e. seasons where breeding is deferred. At Ile de la Possession (Crozet) non-breeding periods lasted on average 1.4 years and occurred approximately every 1.7 years, with sabbatical periods that led to 20-40 % of breeders abstaining from breeding in a particular season (Voisin 1988). Consequently a smaller population with low sabbatical rates could appear larger than a larger population with high sabbatical rates, masking overall trends in the breeding population. This is not really supported for the Falkland Islands by the annual monitoring data, which provides indications of continuing, rather than fluctuating, positive increases in the two monitored sites since the last census (Crofts and Stanworth 2016)

A high degree of fidelity to their breeding island is reported for the species (Voisin 1988); however, the location of nest sites appears much more variable, with nests rarely used in two consecutive years; instead, colonies moved to another area in the general vicinity of the previous location (Voisin 1988). Most Key Sites (locations) in the Falkland Islands have, however, remained unchanged since the 2004/05 census.

Seasonal Variation

Annual monitoring sites in the Islands showed downturns in breeding numbers this season. This was particularly significant for Steeple Jason which has been monitored through the FISMP since 2006 (Crofts and Stanworth 2016). This season was the first notable estimated decline in breeding pairs (down by 33 %) at this location since monitoring began. The 2015/16 season was extremely variable with regards to trends in breeding pairs and breeding success of monitored seabird species (Crofts and Stanworth 2016), correlating with a strong El Niño event. Higher breeding deferral in this season, possibly influenced by seasonal conditions could have led to considerable underestimation of the breeding population.

Survey Methodology

The availability of survey platforms led to the collection of images after the peak egg-laying period (egg-laying occurs generally in October), meaning that some failure by breeding pairs could already have occurred, thus underestimating the number of breeding adults.

The large number of potential breeding sites at remote and un-visited locations means that, aside from those sites surveyed in the 2004/05 census but not covered in the current survey, further sites may have been missed.

There were known locations at Key Sites in 2004/05, that were not counted during the current survey on both Barren and George Islands, that have previously recorded a combined total estimate of 1519 breeding pairs. In the current survey, the breeding pair

estimate for Tea Point Beach at Barren Island had increased by 245 %. If this is representative of the increases more broadly at these island 'sites', estimates for completely un-surveyed areas on Barren (320 pairs) and George (533 pairs) could add 2090 pairs to the population estimate for the Falkland Islands.

Surveys of landowner perceptions of population trends in those bird species that interact with rural livelihoods (Reeves 2015) indicated a strong belief that numbers of SGPs had increased/were increasing. At North Arm settlement numbers have been increasing with eight sites around the coastline supporting several tens of pairs each (S Dixon pers. com.). These were not counted during the current survey.

All of the above considerations point towards the current estimate being a minimum, and that an estimated increase in the population of 7.4 % could be considered conservative. Considering predictive increases in Barren and George Islands (based on a 245 % increase at Tea Point Beach, Barren Island) could put the population at 23,060 pairs, an increase of 18.1 % since 2004/05. However, using the global estimate of c. 48,900 pairs, and the minimum estimate of 20,970 ± 180 breeding pairs, the Falkland Islands remain the most significant breeding location for this species, supporting around 43 % of the global population.

Sites

Indications are that this species may move within general breeding locations (Voisin 1988). This is substantiated by monitoring of the SGP colonies at Steeple Jason in the Falkland Islands where a decline in one colony (a complete loss of around 400 breeding pairs) was matched by an increase in others close-by, such that the overall population at the location remained stable (Crofts and Stanworth 2016). Indications from the current survey are that most spatial changes, however, are evident in smaller colonies at mainland locations, which may be much more ephemeral in nature as breeding sites, possibly through disturbance. Key Sites appear to have more resilience as breeding locations, being less visited generally.

Breeding site availability for the species is unlikely to have been a limiting factor in recent times, or have the potential to be so in the future. The large number of offshore islands provide numerous suitable sites for colonies, many with erosion problems that provide the bare ground apparently favoured by the species for nesting sites around the Islands. There may be some indications that increasing colony sizes may come at a reproductive cost, with reduced breeding success correlating with increasing colony size at an annual monitored site on Steeple Jason (Crofts and Stanworth 2016), which could limit population increases. On Golden Knob, habitat changes (which may have resulted in, or from colony abandonment), have seemingly reduced nesting opportunities at a sandy site, though this appears unusual. Although habitat for potential breeding sites is distributed widely around the Islands, as with several other seabird species within the Islands, such as Black-browed Albatross *Thalassarche melanophrys*, Thin-billed Prion *Pachyptila belcheri* and Brown Skua *Catharacta antarctica* (Woods and Woods 1997) the distribution appears to be focussed to the South and West of the Islands.

Conclusions

The minimum breeding population of SGP at the Falkland Islands was estimated to be $20,970 \pm 180$ pairs, an increase of 7.4 % since the previous census in 2004/2005. This trend aligns with landowner perceptions that the population of this species continues to increase within the Islands. Threats such as egg harvesting and persecution due to interactions with livestock have significantly reduced if not ceased. Major threats remain to be disturbance, (the species at the Falklands is prone to nest abandonment when disturbed at breeding sites), and fisheries by-catch, both within the Falklands waters, but likely more significantly beyond it. Uncertainties around other threats, such as climatic changes/El Niño and increasing evidence of plastic ingestion in seabirds remain unknown for this species in the Islands.

The current Falkland estimate would increase the global population estimate by 1441 pairs to 48,239 pairs of which the Falklands would constitute 43 %. Apparent opportunities remain for this species to continue to increase within the Falklands as suitable nesting habitat remains widely available.

Further long-term annual monitoring of colonies is important in supporting and interpreting snapshot surveys of the wider population at longer intervals.

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Appendix 1. Site breeding pair count estimates

Site	Area	Method	date	AON	Method	Date	PFC	Final Pair Estimate
Steeple Jason	The Neck	direct	26/10/15-3/11/15	929±48	direct	14-15/3/15	424±3	
	NW Flat	direct	26/10/15-3/11/15	6	direct	14-15/3/15	0	
	South of Ridge	direct	26/10/15-3/11/15	450±10	direct	14-15/3/15	115±0	
	House	direct	26/10/15-3/11/15	0	direct	14-15/3/15	0	
	Above East BBA	direct	26/10/15-3/11/15	0	direct	14-15/3/15	0	
Grand Jason	Total	estimated from PFC	NA	1385±48 1,446±57	photo	2/2/16	746±36	1,384±48 1,446±57¹
Sea Lion		direct	throughout season	0				0
Pebble Island	Green Rincon	direct	27/11/15	183±4				183±4
Dunbar	Hope Point	direct	throughout season	0				0
Governor Island		photo	7/1/16	348±2				348±2
West Island		estimated from PFC	NA	168±8	photo	2/2/16	87±4	168±8¹
Dyke Island					photo	2/2/16	0	0
Albemarle	Rookery Point	direct	throughout season	0			0	0
Barren Island	Tea Point Beach	photo	2/12/15	2187±187				2,187±137
	Tea Point	estimated from PFC	NA	375±20	photo	2/2/16	193±6	375±20¹
George Island	Peat Bog Point	estimated from PFC	NA	264±12	photo	2/2/16	136±6	264±12¹
Swan Island	North	estimated from PFC	NA	22	photo	2/2/16	11	22¹
	South	estimated from PFC	NA	11	photo	2/2/16	6	11¹
Bleaker Island					direct	20-21/2/16	310	403 ²
Elephant Beach	Black Point	direct	throughout season	0			0	0
Cape Dolphin	Swan Pond Point	direct	throughout season	0			0	0
Penn Island		estimated from PFC	NA	872±5	photo	2/2/16	494±7	872±5¹
Speedwell Island	Between Tank and Annie Point	estimated from PFC	NA	545±33	photo	2/2/16	281±4	545±33¹
	Point Bay	estimated from PFC	NA	123	photo	2/2/16	64±9	123¹
Third Passage		photo	2/12/15		photo	2/2/16		359±10³
Golden Knob		photo	2/12/15	265±2				265±2¹
Sandy Cay		photo	2/12/15		photo			11,670±54⁴
Ship Island		direct	4/1/16	292			126	292
Walker Creek		direct	16/11/15	25				25
New Island		direct	4/1/16	24			12	24
Beauchene Island		direct	15/12/15	4				4
Total								20,970±180

*1 calculated using mean breeding success (0.52±0.06 chicks per pair)

*2 calculated using breeding success estimate from Bleaker Island (0.77 chicks per pair)

*3 calculated partly from AON (99±5 AON) and partly from PFC using breeding estimate from Third Passage Island

*4 calculated partly from AON (11,205±52 AON) and partly from PFC using breeding success estimate from Sandy Cay