



# Falkland Islands Seabird Monitoring Programme

## Annual Report 2020/2021 (SMP28)

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## Summary

The Falkland Islands support seabird populations that are of global importance; both numerically, and in terms of conservation status. Accordingly, fluctuations in local populations may substantially affect the global conservation status of these species.

The Falkland Islands Seabird Monitoring Programme (FISMP) monitors Gentoo Penguin (*Pygoscelis papua*) at 11 sites (17 colonies), Southern Rockhopper Penguin (*Eudyptes c. chrysocome*) at five sites (14 colonies) and Magellanic Penguin (*Spheniscus magellanicus*) at one site (one colony). King Penguin (*Aptenodytes patagonicus*) and Black-browed Albatross (*Thalassarche melanophris*) are monitored at single, but key sites, in terms of population numbers. Southern Giant Petrel (*Macronectes giganteus*) is monitored at one site (two colonies), Imperial Shag (*Phalacrocorax atriceps*) at three sites (four colonies) and Brown Skua (*Catharacta antarctica*) at one site (four colonies).

### Summary results of FIMSP 2020

Breeding pair numbers of Gentoo Penguin and Southern Rockhopper Penguin at FISMP sites continued to show no clear signs of a recovery following the significant drop in breeding pair numbers in 2016 (when a strong El Niño Southern Oscillation event was in place). Breeding pair numbers of Black-browed Albatross, Southern Giant Petrel, Magellanic Penguin, Brown Skua, and King Penguin pre-fledged chicks at FISMP sites appeared stable or increasing. In general, breeding success across the species was improved in 2020 when compared to the previous year.

Neutral El Niño Southern Oscillation (ENSO) and La Niña conditions dominated the period of October 2020 to March 2021.

**Gentoo Penguin** breeding pair numbers at the FISMP sites showed a decrease of 6 % when compared with 2019. Breeding pair numbers have remain relatively static following the significant drop during 2016, and currently are at 36 % below the 2015 maximum value. In 2020, overall breeding success (1.14 chicks/pair) was above the FIMSP long-term annual average (0.95 chicks/pair).

**Southern Rockhopper Penguin** breeding pair numbers decreased by 1 % when compared to 2019. Breeding pair numbers have remain relatively unchanged following the significant drop during 2016, and currently are at 29 % below the 2015 maximum value. In 2020 breeding success was highly variable between locations and overall performance remained below the long-term annual average for the sixth consecutive year.

**Magellanic Penguin** burrow occupancy at Gypsy Cove was broadly associated with the extent of tussac grass habitat. The 2020 occupancy rate of 32.4 % had increased from the previous year (27.7 %), and was just below the annual average for this monitored site (33.0 %).

**King Penguin** numbers of pre-fledged chicks at Volunteer Point was 866, an increase of 5 % when compared with 2019, and the highest value recorded since monitoring began in 1980. The long-term monitoring at this site shows periodic fluctuations with an overall upward trend.

**Imperial Shag** numbers continued to fluctuate seasonally at monitored sites. There was no clear indication of a strong downward or upward trend.

**Brown Skua** numbers of Apparently Occupied Territories (AOT) at Steeple Jason increased by 8 % and productivity (the ratio of eggs/chicks per adult territory) also increased when compared with 2019.

**Black-browed Albatross** breeding pair numbers at the monitoring sites at Steeple Jason showed an overall decrease of 1 % when compared with 2019. Taking into account annual fluctuations, the overall FISMP trend suggests a stable population. The overall breeding success in 2020 remained below the annual average for the sixth consecutive year, although was improved when compared with 2019.

**Southern Giant Petrel** breeding pair numbers at Steeple Jason increased by 6 % when compared with 2019. The overall increase reflected the positive trend at the Neck colony, whereas the Northwest colony continued to decline. In 2020, breeding success of 15 % was well below the long-term annual average of 32 %.

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## Introduction

The Falkland Islands support seabird populations that are of global importance, both numerically, and in terms of conservation status. An estimated 72 % of the global population of Black-browed Albatross (*Thalassarche melanophris*) breeds in the Falkland Islands (ACAP 2017, BirdLife International 2016). This species was down listed to 'Least Concern' on the IUCN Red List in 2017. The Falklands are also home to approximately 36 % of the world's population of Southern Rockhopper Penguin (*Eudyptes c. chrysocome*) (Red Listed as 'Vulnerable') and approximately 30 % of the world's population of Gentoo Penguin (*Pygoscelis papua*). The Gentoo Penguin was recently down listed from 'Near Threatened' to 'Least Concern' (IUCN 2017). Accordingly, fluctuations in local populations may substantially affect the global conservation status of these species.

Falklands Conservation initiated the Falkland Islands Seabird Monitoring Programme (FISMP) in 1989/90. Its initial purpose was to monitor the diet and population dynamics of Gentoo Penguin, Magellanic Penguin (*Spheniscus magellanicus*), Southern Rockhopper Penguin, and Black-browed Albatross. Diet sampling was discontinued in 2003. Since then, population monitoring has continued on an annual basis with some changes taking place to the original format, such as the addition and loss of some monitoring sites and the addition of other species.

Currently the FISMP monitors Gentoo Penguin (*Pygoscelis papua*) at 11 sites (17 colonies), Southern Rockhopper Penguin (*Eudyptes c. chrysocome*) at five sites (14 colonies) and Magellanic Penguin (*Spheniscus magellanicus*) at one site (one colony). King Penguin (*Aptenodytes patagonicus*) and Black-browed Albatross (*Thalassarche melanophris*) are monitored at single, but key sites, in terms of population numbers. Southern Giant Petrel (*Macronectes giganteus*) is monitored at one site (two colonies), Imperial Shag (*Phalacrocorax atriceps*) at three sites (four colonies) and Brown Skua (*Catharacta antarctica*) at one site (four colonies).

Based on the last Island Wide Census in 2010, monitored colonies made up approximately 18 % of the Falklands' breeding population of Gentoo Penguin (estimated at 132,000 breeding pairs; Baylis et al. 2013a), approximately 2.6 % of the Falklands' breeding population of Southern Rockhopper Penguin (estimated to be 319,000 breeding pairs; Baylis et al. 2013b) and approximately 0.5 % – 0.6 % of the total Falklands' breeding population of Black-browed Albatross (estimated to be between 475,500 and 535,000 breeding pairs; Wolfaardt 2012). The monitoring site for Southern

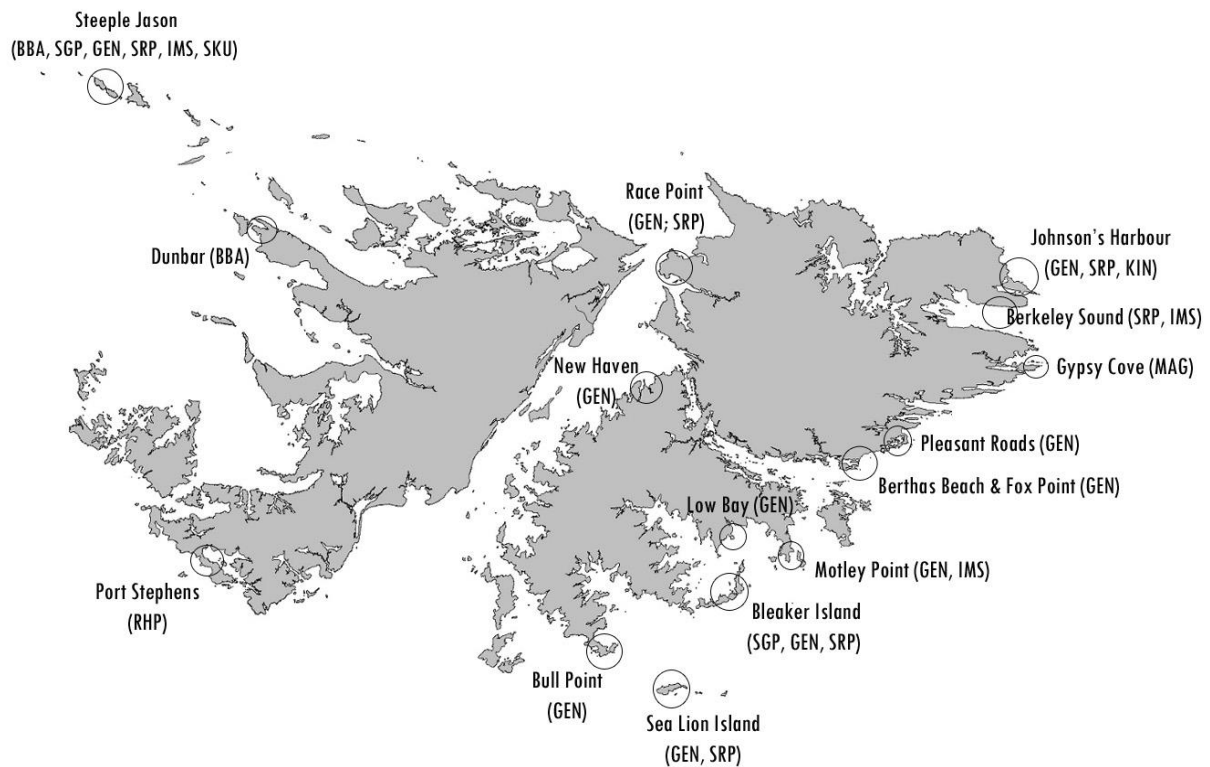
Giant Petrel made up approximately 8.6 % of the total Falklands' breeding population based on the latest 2015/16 Island-wide census (Stanworth & Crofts 2017). The only population estimate for Magellanic Penguin in the Falkland Islands is for 76,000 to 142,000 pairs (Woods and Woods 1997). As a very rough estimate, the current monitoring site is likely to represent less than one percent of this. Woods and Woods (1997) also provide the only population estimates for Imperial Shag (45,000 – 85,000 pairs) and Brown Skua (5,000 – 9,000 pairs) for the Falkland Islands. On this basis the FISMP monitors approximately between 2 % and 4 % of the Imperial Shag and Brown Skua breeding populations. The current monitoring site for King Penguin at Volunteer Point is likely to represent over 95 % of the breeding population in the Falklands. The relatively small numbers of King Penguins at other locations are not systematically monitored.

The information gathered as a result of the FISMP has contributed to the identification of local, regional and global conservation priorities and provides information necessary for IUCN Red Listing assessments. The FISMP provides an important long-term data set on population trends and breeding success, which further contributes to other areas of research.

This report details monitoring results from the 2020/2021 breeding year as well as contributed data collected by landowners at Dunbar and Bleaker Island settlements.

## Materials and methods

Within this report, breeding periods are referred to by the year in which they commenced, for example; 2020 describes the 2020/2021 austral summer breeding period. 'Location' or 'site' refers to a named geographical area, such as a settlement or 'camp', and this may support more than one colony. For example, Johnsons Harbour has Gentoo Penguin colonies at Volunteer Green, Lagoon Sands and at Cow Bay; Race Point has Gentoo Penguin colonies at Rookery Sands and Fanning Harbour. 'Colony' refers to a group or groups (sub-colonies) of birds in close proximity, typically within 50-100 m of each other and/or with the same or proximate access from the sea. Monitoring locations are shown in **Figure 1**, exact grid references are provided in **Appendices 2 to 5**.



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**Figure 1:** Map of the FISMP monitoring locations.

The work was carried out by Falklands Conservation under Falkland Islands Government Research Licence No: R40/2018.

In addition to those counts undertaken by Falklands Conservation (below), counts have also been undertaken at Dunbar (Black-browed Albatross) and Bleaker Island (Southern Giant Petrel, Southern Rockhopper and Gentoo Penguin) by the landowners. Any variation from the standard methodology is reported in the text.



## **Gentoo Penguin**

Apparently Occupied Nests (AON) of Gentoo Penguins were counted during egg-laying, over the period 2 - 19 November 2020 to provide a breeding pair estimate. The number of chicks was counted before fledging (Pre-Fledged Chicks (PFC)), during the period 4-20 January 2021, and used to estimate breeding success. The monitoring locations (colonies in brackets if more than one) were:

- Johnsons Harbour (Volunteer Green, Cow Bay and Lagoon Sands);
- Race Point (Fanning Harbour and Rookery Sands);
- Sea Lion Island;
- New Haven;
- Bull Point (Bull Point and Bull Roads);
- Motley Point;
- Low Bay;
- Bertha's Beach;
- Fox Point;
- Pleasant Roads; and
- Steeple Jason (House and Neck).

## **Southern Rockhopper Penguin**

Southern Rockhopper Penguin breeding pair counts (using AON) were performed from the commencement of egg-laying during the period 27 October to 20 November 2020. Chick counts (PFC) were carried out over 6-21 January 2021. A new study colony (Steeple Jason S5 Finger) was added in 2019. The locations (colonies in brackets if more than one) were:

- Steeple Jason (Northwest Flat, Northwest Ridge, S5Tip, Southeast Study and S5 Finger);
- Sea Lion Island (Rockhopper Point);
- Race Point (Fanning Head North and Fanning Head South);
- Berkeley Sound (Diamond Cove, Rugged Hill and Eagle Hill); and
- Port Stephens (Stephen's Peak).

## **Magellanic Penguin**

Transects were carried out every 100 m (approximately) from Engineer Point to the Car Park at Gypsy Cove on 4 December 2020. Transects were 4 m wide, starting from the shore line, and running perpendicular to it, for a distance 40 m further than the last burrow found. Using a pole with torch attached, burrows within the transect were categorised as either 'occupied',

'unoccupied' or 'unknown' if it was not possible to determine occupancy. Burrow density was derived from each transect as number of burrows in the transect area from the start of the transect to as far as the last recorded burrow.

### **King Penguin**

The majority (around 95 %) of the Falkland Islands population of King Penguins is found at Volunteer Point. This population has been monitored annually since the onset of the FISMP, with the first independent counts having been performed earlier, since 1980. A few individuals also breed at nearby Lagoon Sands. The breeding cycle of King Penguins extends over a year and consequently is not synchronised to summer breeding as with the other penguin species. The chosen unit of measure for King Penguin is pre-fledged chicks (PFC) that have survived the winter. This is not a measure of the total number of chicks produced (as some will have perished over the winter), nor is it an exact indicator of the number of breeding pairs. The counts were conducted on 19 November 2020.

### **Imperial Shag**

Counts of Imperial Shag (AON) were conducted at Motley Point (14 January 2021), Berkeley Sound (Eagle Hill and Rugged Hill on 9 January 2021) and Steeple Jason (21 January 2021). Due to the variable breeding times of Imperial Shag, numbers derived represented the numbers of active nests during the January monitoring period.

### **Brown Skua**

Brown Skua counts were initiated on Steeple Jason in 2016. Counts of Apparently Occupied Territory (AOT) were conducted at Steeple Jason between 18 and 20 January 2021. Due to the restricted monitoring window at Steeple Jason AOTs were classified by a territory with egg/s and or chick/s observed or an adult sitting tightly on a nest and assumed to be incubating/brooding. All territories were recorded with a GPS position.

### **Black-browed Albatross and Southern Giant Petrel**

Counts of Black-browed Albatross and Southern Giant Petrel breeding pairs (AON) at Steeple Jason were performed between 3 and 9 November 2020, and in order to estimate breeding success, chicks (PFC) from these colonies were counted between 1 and 4 April 2021. Two colonies of Southern Giant Petrel and six sub-colonies of Black-browed Albatross were monitored. Since 2019 the Black-browed Albatross Penthouse colony chick numbers were no longer incorporated into the

site average breeding success due to its small size, this was the case again in 2020. All counts since 2004 were re-calculated to exclude the Penthouse colony. A new study colony (Steeple Jason S5 Finger) for Black-browed Albatross was added in 2019.

### **Landowner Counts**

Counts of Black-browed Albatross breeding pairs at Penguin Point South were not achieved in 2020. Counts were made at Bleaker Island by the landowner for Gentoo Penguin (10 November 20120 and 15 January 2021), Southern Rockhopper Penguin (25 November 2020 and 20 January 2021) and Southern Giant Petrel chicks (25 February 2021).

### **Count methods**

Whenever possible, the total counts (using the above count units) were made at individual locations, whilst in the field, by paired observers (**Appendix 1**). The decision to utilise photo counting was made on an individual colony/sub-colony basis, where it was felt that a paired tally count in the field would not provide a reliable estimate. This was generally due to the size of some colonies (e.g. Steeple Jason Neck).

In some instances, for chick counting, large numbers of highly mobile chicks had merged sub-colonies over large areas. Here again, it was felt, that reliable estimates could not be derived and the decision was made to count the other sub-colonies that had remained distinct. These counts still related to individual breeding pair numbers from the counts earlier in the summer, and from this breeding success could be derived; in essence a sub-sampling technique. The various methods, or combination of methods, employed for each location/colony are presented in **Appendices 2 to 5**. Grid references of individual colonies (due south of the approximate centres, 5m from the colony edge) were taken where possible and are provided in **Appendices 2 to 5**.

### **Field counts**

Whenever possible, counts were made at least three times by two or more observers using tally counters in accordance with standard methods (Thompson & Riddy 1993). These counts (and those few of reduced replication) were subsequently averaged to give estimates of breeding pair and chick numbers. These counts are referred to as 'Tally repeated'. Counts at Penguin Point South, Dunbar and Bleaker Island were single counts by a single observer. In some instances, groups or count unit numbers were so small that it was felt the number of count units could confidently be counted without error on a single occasion. These counts are referred to as 'Tally

agreed'. Breeding success is expressed on graphs as the number of chicks per breeding pair for species with two or more chicks and as a percentage for those with one chick.

### **GoPro Counts**

A GoPro HD Hero camera was pole mounted and held aloft from a vantage point to a height of approximately 5 m whilst a minimum of three photos were taken in 1920x1080 resolution in jpeg format giving a 127° field of view. Where colonies were too large to fit into a single photograph, markers or natural features were used to subdivide the colonies into sections that could be photographed. There was no evidence of disturbance in the colonies from using this technique. Images were downloaded and counted using ImageJ software. Counts were repeated a minimum of four times by two counters and the average taken. These are referred to in Tables as 'GoPro counts'.

### **Drone counts**

DJI Phantom 4 drones were trialled in 2016 to capture aerial images of colonies under FIG Research Licence No: R13/2016. All operations were conducted at a minimum launch distance of 15 m from a colony and reaching a minimum flying altitude of 15 m when directly over colonies. Greater caution was used when operating the drone at flying seabird colonies. Drone use is prohibited by the landowner at Volunteer Point and therefore was not used at this site. The inbuilt camera produces 4000x3000 resolution jpeg format images giving a 94° field of view. There was evidence that birds were aware of the drone but no evidence to suggest disturbance of breeding birds in the colonies using this method (Crofts 2017). Images were downloaded and counted using ImageJ software. Counts were repeated a minimum of four times by two counters and the average taken. These are referred to in Tables as 'Drone counts'.

### **Comparison of differing counting methods**

Multiple count data for the same colony using two or more of the methods were stored for future comparative work. For the purpose of this report, where multiple counting methods exist for the same colony, the data used were those that exhibited the least error between counts. Where possible the same counting method was used to calculate breeding success for each colony.

## **Environment**

Global environmental conditions and sea surface temperatures are influenced by the natural climate phenomenon of the El Niño Southern Oscillation (ENSO). ENSO is the dominant feature of climate variability on inter-annual timescales (for description see:

<https://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks/el-nino-la-nina/enso-description>).

The ENSO is used to describe the environmental proxy for the FISMP reporting period. Data and forecasts are taken from the [Climate Prediction Center](#). Any atypical oceanographic features observed at the Falkland Islands are sourced from personal communications with the Falkland Islands Fisheries Department.

## **Anthropogenic and other impacts at colonies**

The first measures of anthropogenic and other impacts were introduced to FISMP in 2017. The measures currently involve recording:

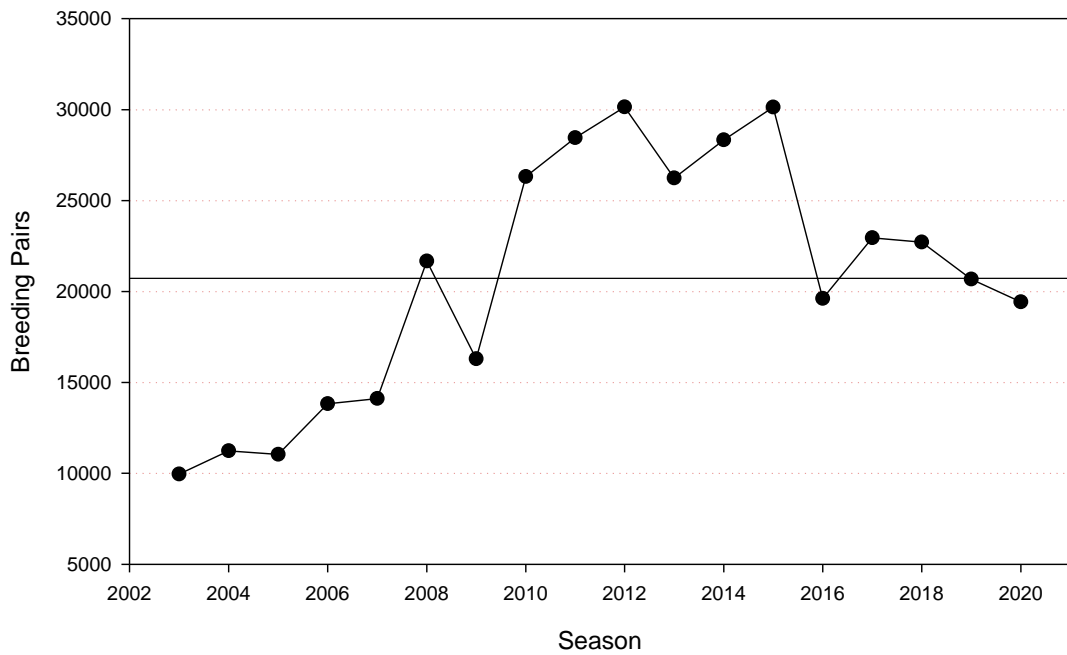
- 1) Direct evidence of marine plastics observed in and around the colonies;
- 2) Any signs of oiling to seabirds;
- 3) Evidence of entanglement or ingestion of fishing gear or other items;
- 4) External signs or symptoms of disease.

# Results

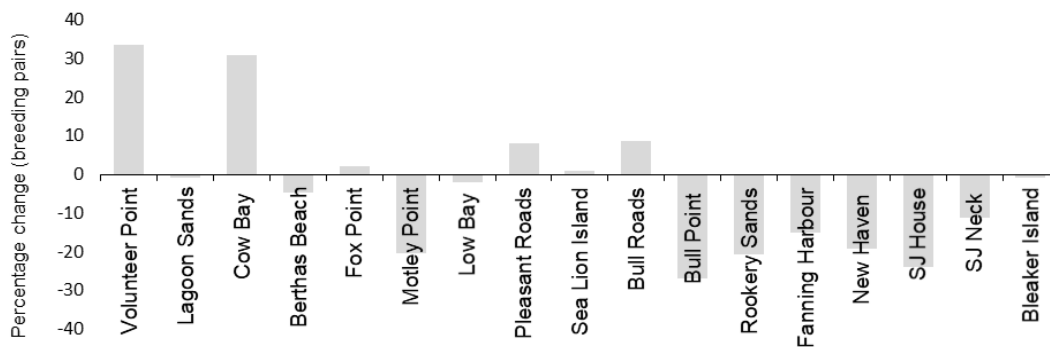
## Gentoo Penguin

### Breeding pairs

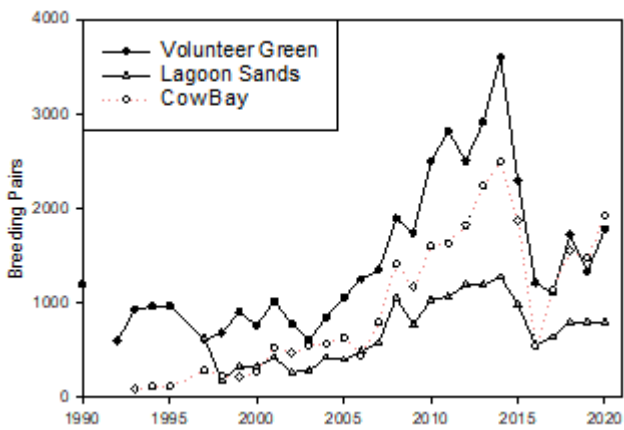
There is a complete data set for the current annually monitored locations (excluding Pleasant Roads, Bleaker Island) for the last 18 years. The combined total of estimated breeding pairs for these locations is shown in **Figure 2**. At these monitored sites, the estimated total number of breeding pairs in 2020 was 19,432, a decrease of 6 % or 1,245 pairs when compared to 2019.



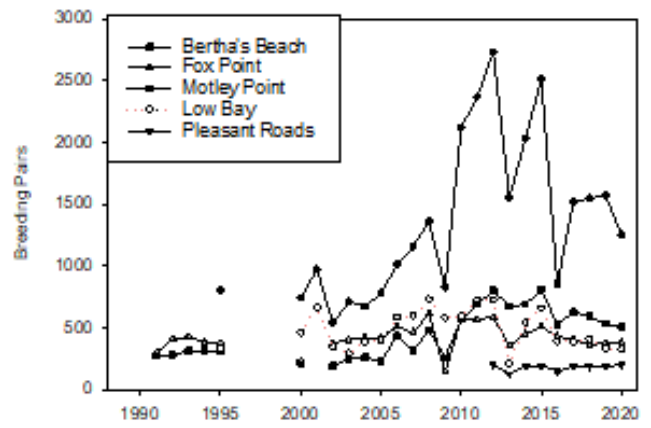
**Figure 2:** Gentoo Penguin breeding pairs at the FISMP locations, 2003–2020. (Solid line – annual average).



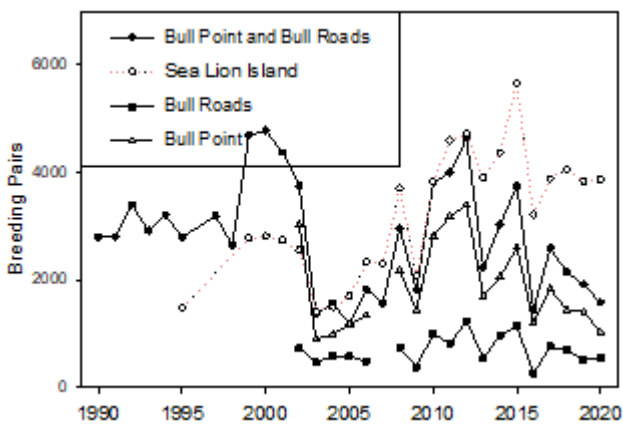
**Figure 3:** Percentage change of Gentoo Penguin breeding pair numbers between 2019 and 2020 at individual FISMP locations.



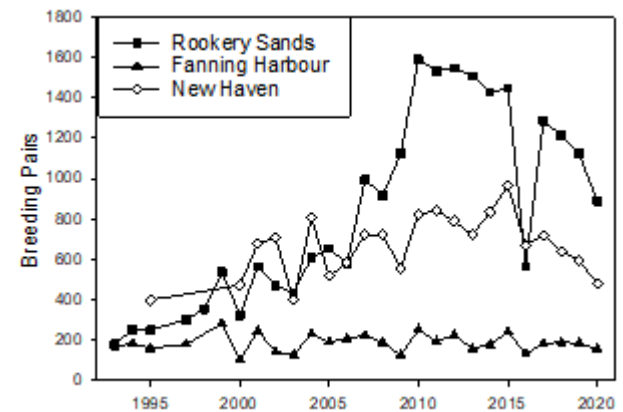
**Figure 4:** Gentoo Penguin breeding pairs for locations in Northeast Falkland.



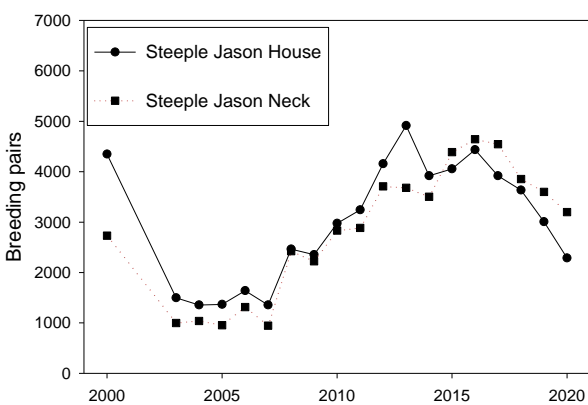
**Figure 5:** Gentoo Penguin breeding pairs for locations in Mideast Falkland.



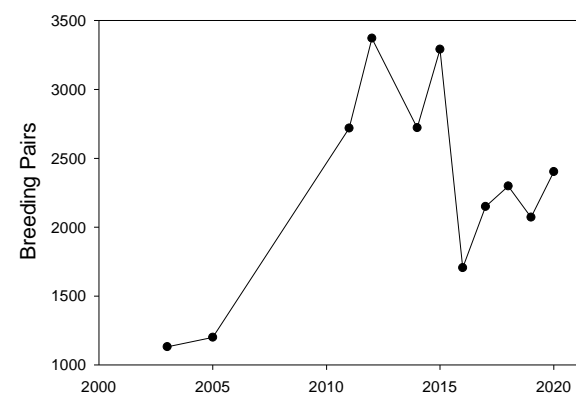
**Figure 6:** Gentoo Penguin breeding pairs for locations in Southeast Falkland.



**Figure 7:** Gentoo Penguin breeding pairs for locations on Falkland Sound.



**Figure 8:** Gentoo Penguin breeding pairs for locations on Steeple.



**Figure 9:** Gentoo Penguin breeding pairs for Bleaker Island.

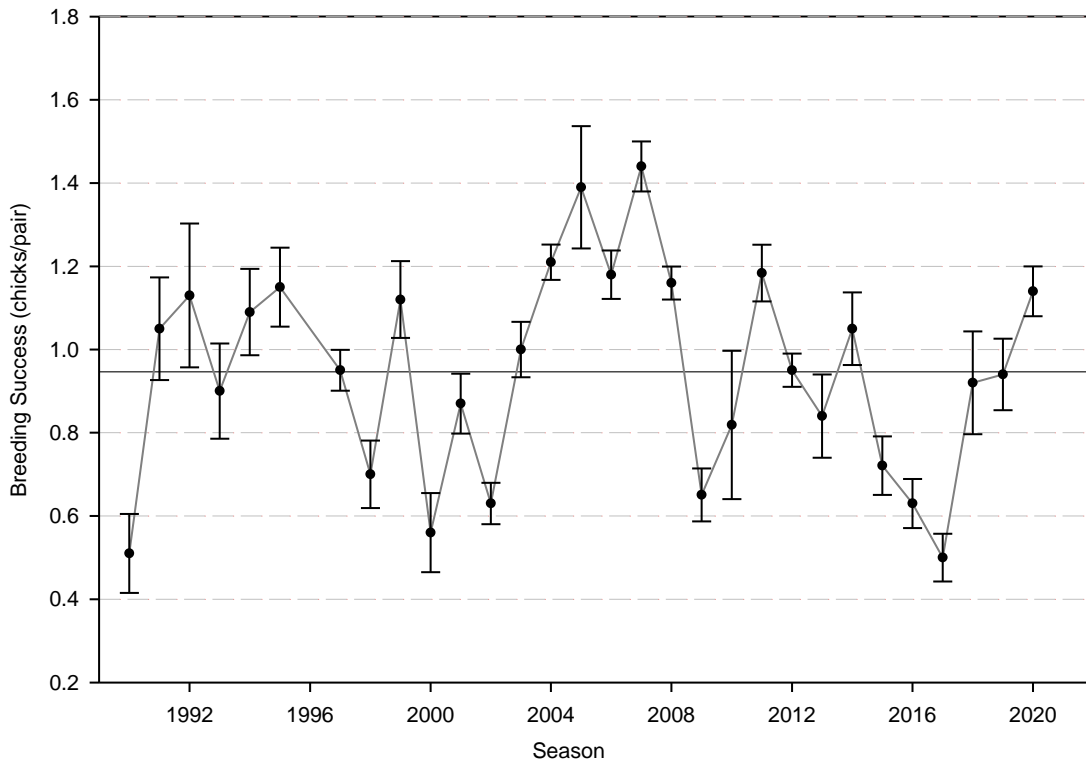
Of all the Gentoo Penguin colonies monitored (n=17), eleven (65 %) showed a decrease in breeding pair numbers when compared with 2019. (**Figure 3**).

Regionally, two of the Gentoo Penguin colonies in the Northeast region showed a notable total increase when compared to breeding pair numbers from 2019, with Volunteer Green increasing by 34 %, and Cow Bay by 31 % (**Figure 4**). Gentoo Penguin breeding pairs for locations in Mideast Falkland varied with Pleasant Roads showing the largest increase at 8 %, and Motley Point showing the largest decrease at 20 % when compared with 2019. (**Figure 5**). The largest change in pair numbers within the Southeast Gentoo Penguin colonies was a decrease at Bull Point at 27 %. Bull Roads increased by 8 % and Sea Lion Island by 1 %. Bleaker Island decreased marginally by 1 % (**Figure 6 and 9**). Falkland Sound colonies all demonstrated notable decreases with Rookery Sands down by 21 %, New Haven down by 19 %, and Fanning Harbour down by 15 % (**Figure 7**). Both colonies at Steeple Jason decreased for a fourth consecutive year with the House down by 24 % and the Neck by 11 % (**Figure 8**).

### ***Breeding success***

The average estimated breeding success for all colonies was  $1.14 \pm 0.21$  chicks/pair in 2020; an increase from  $0.94 \pm 0.32$  chicks/pair in 2019. The 2020 breeding performance was above the FISMP long-term annual average (0.95 chicks/pair) and had improved year on year from the 2017 low of  $0.5 \pm 0.21$  chicks/pair (**Figure 10**).



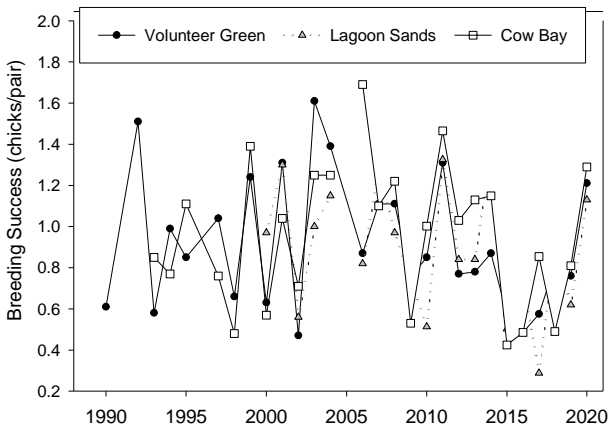


**Figure 10:** Gentoo Penguin breeding success at FISMP locations, 1990-2020.

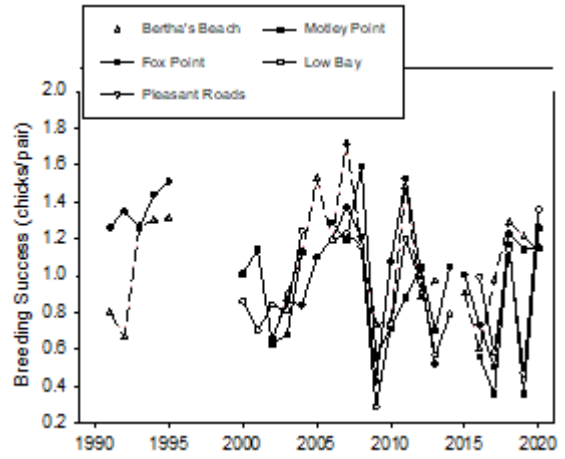
(Solid line – annual average). Standard Error bars show error about the overall mean by site means, and do not incorporate error about individual sites.

Breeding success varied between locations from a minimum of 0.79 chicks/pair at Steeple Jason House and 0.80 chicks/pair at Rookery Sands and Steeple Jason Neck, to a maximum of 1.40 chicks/pair at New Haven (**Figures 11 to 15**). On the whole, breeding success for the majority of the sites reflected an improvement when compared to the previous five seasons.

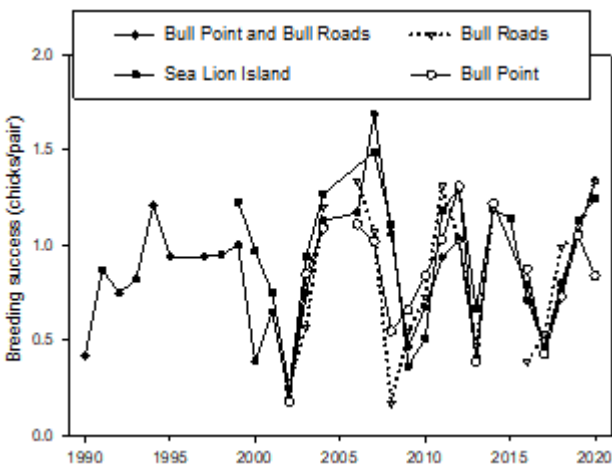
At Steeple Jason, the FIMSP data suggests an apparent long-term trend of decreasing breeding success for both the Gentoo Penguin colonies between 2004 and 2018 (**Figure 15**). In 2020, the average breeding success for Steeple Jason was  $0.80 \pm 0.01$  chicks/pair; only the second year since 2012 that breeding success reflected the long-term annual average (0.8 chicks/ pair) for this site.



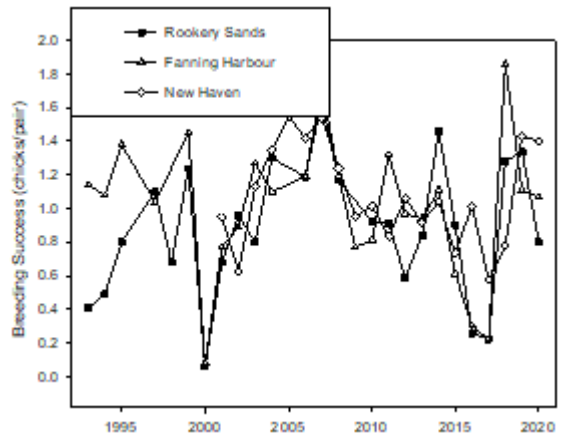
**Figure 11:** Gentoo Penguin breeding success for locations in Northeast Falkland.



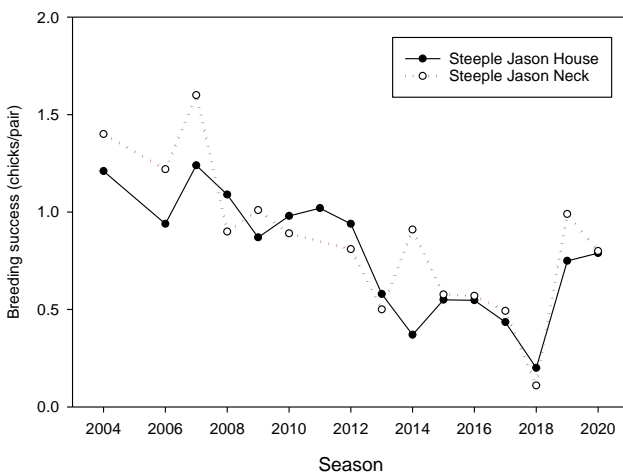
**Figure 12:** Gentoo Penguin breeding success for locations in Mideast Falkland.



**Figure 13:** Gentoo Penguin breeding success for locations in Southeast Falkland.



**Figure 14:** Gentoo Penguin breeding success for locations on Falkland Sound.

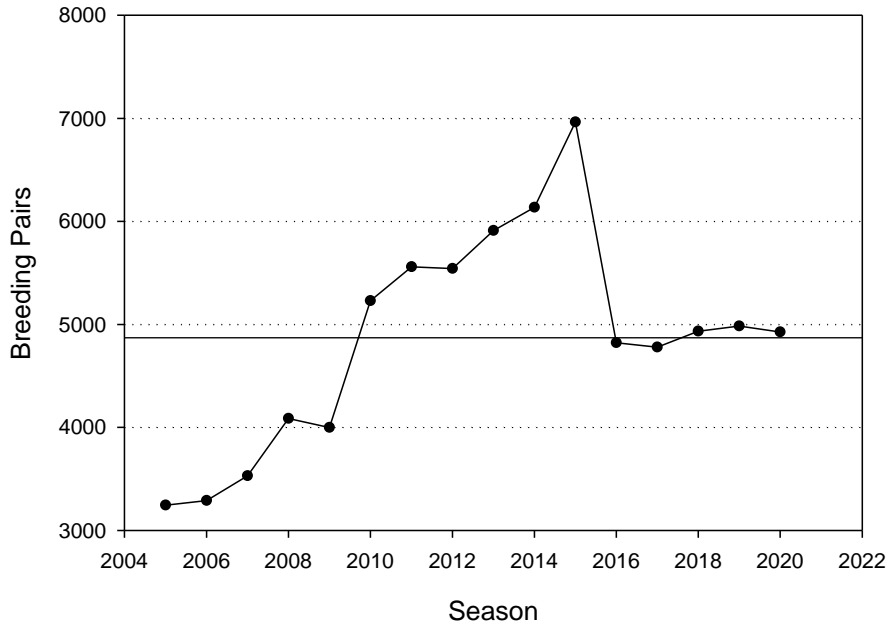


**Figure 15:** Gentoo Penguin breeding success for locations on Steeple Jason.

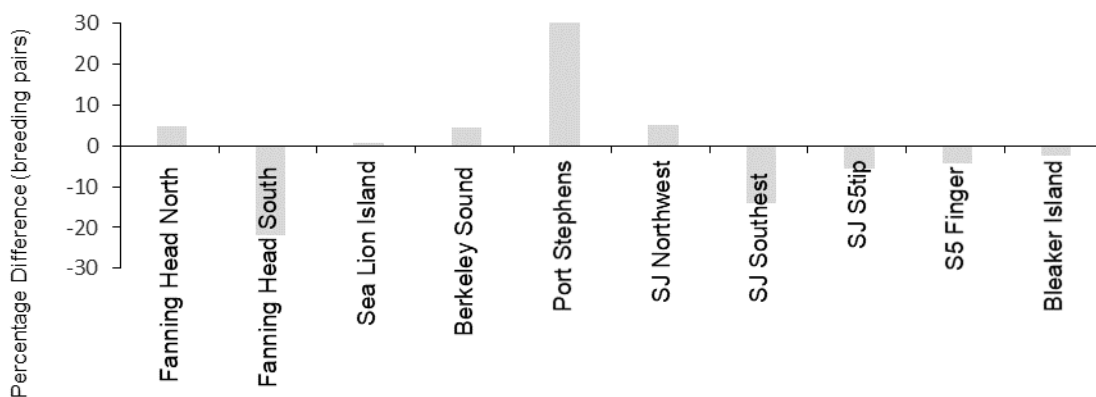
## Southern Rockhopper Penguin

### Breeding pairs

Five locations have been monitored annually since 2005 (Race Point, Steeple Jason Southeast, Steeple Jason Northwest, Sea Lion Island and Berkeley Sound). At these sites, the combined total estimate of the number of breeding pairs was 4,926 in 2020; this represented a decrease of 1 % from the 4,984 breeding pairs estimated in 2019 (**Figure 16**).



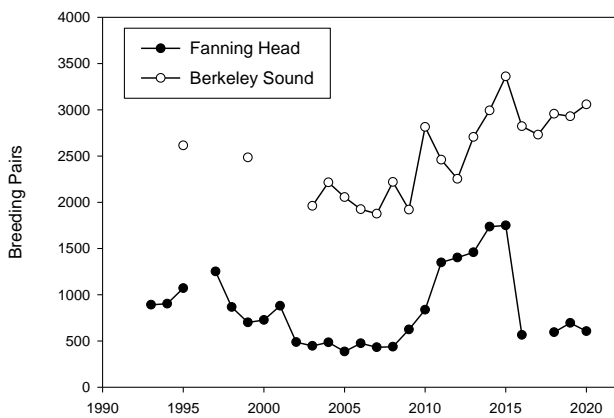
**Figure 16:** Southern Rockhopper Penguin breeding pairs at FISMP locations 2005-2020. (Solid line – annual average).



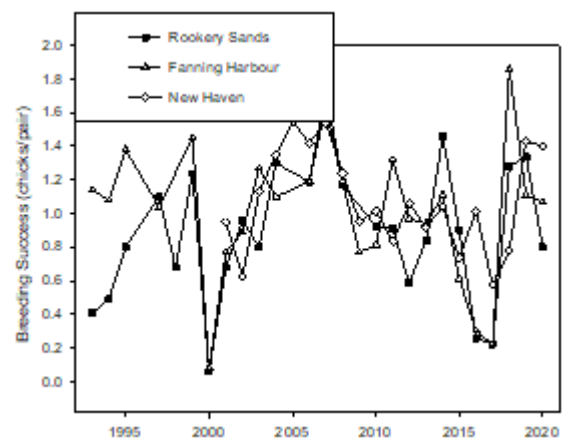
**Figure 17:** Percentage change of Southern Rockhopper Penguin breeding pair numbers between 2019 and 2020 at individual FISMP locations.

Of the ten monitored colonies, 5 showed decreased breeding pair numbers when compared to 2019; Fanning Head South (22 %) Steeple Jason Southeast (14 %), Steeple Jason S5Tip (6 %), Steeple Jason S5 Finger (4 %), and Bleaker Island (2 %). The remaining 5 colonies showed increased breeding numbers; Port Stephens (61 %), Steeple Jason Northwest (5 %) Fanning Head North (5 %), Berkeley Sound (4 %) and Sea Lion Island (1 %) (**Figure 17**).

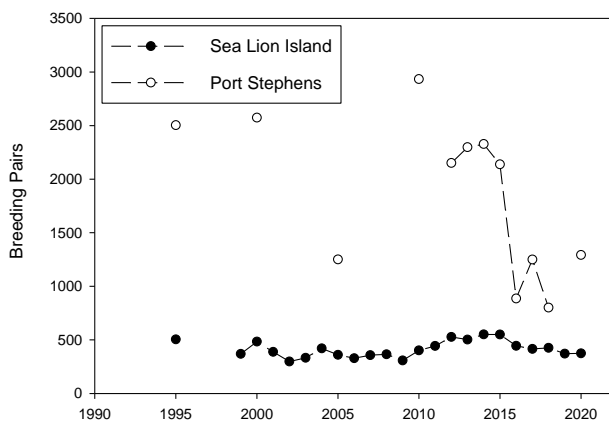
The largest increase in breeding pair numbers was seen at Port Stephens at 61 % (491 pairs). The largest decreases in breeding pair numbers was 22 % (100 pairs) at Fanning Head South and Steeple Jason Southeast at 14 % (111 pairs). For the remaining sites, values were similar to those of 2019. (**Figures 18 to 21**).



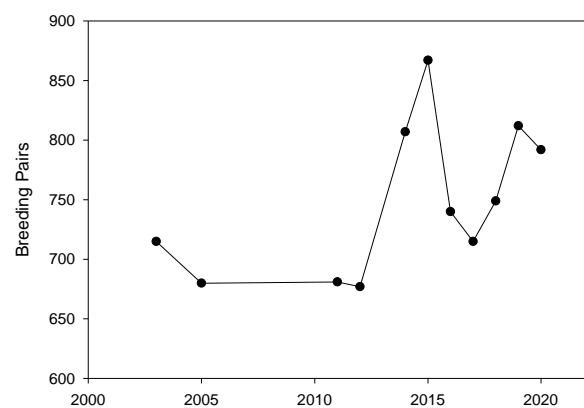
**Figure 18:** Southern Rockhopper Penguin breeding pairs for locations in mainland East Falkland.



**Figure 19:** Southern Rockhopper Penguin breeding pairs for locations on Steeple Jason



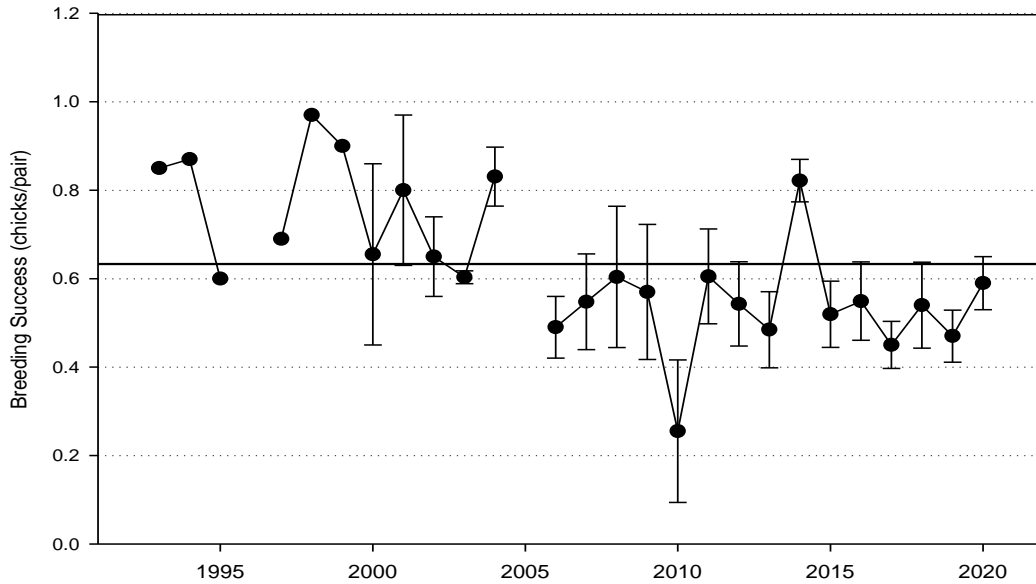
**Figure 20:** Southern Rockhopper Penguin breeding pairs for locations in South Falklands.



**Figure 21:** Southern Rockhopper Penguin breeding pairs for Bleaker Island.

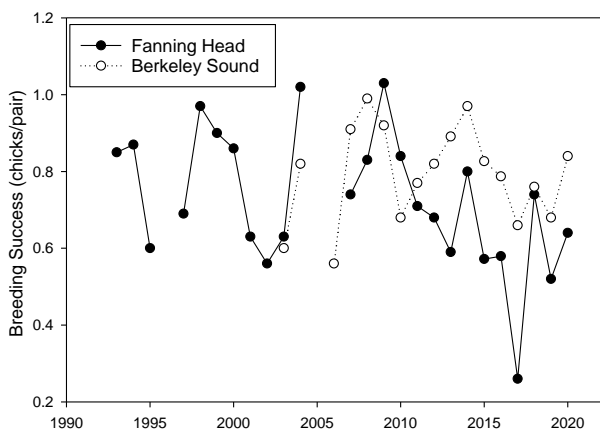
### Breeding success

Average breeding success for Southern Rockhopper Penguin in 2020 was  $0.59 \pm 0.16$  chicks/pair, an increase from  $0.47 \pm 0.15$  chicks/pair in 2019. The figure, however, remained below the annual average ( $0.63 \pm 0.13$  chicks/pair) for the sixth consecutive year (**Figure 22**).

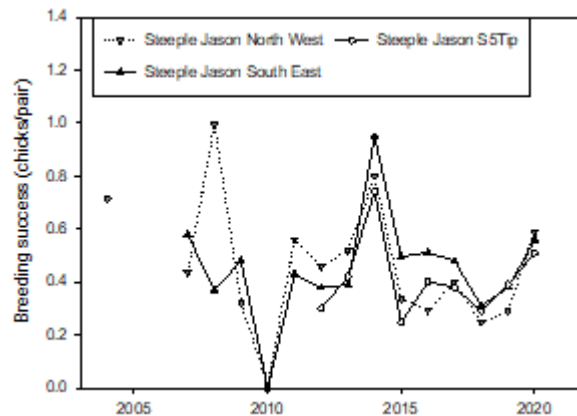


**Figure 22:** Southern Rockhopper Penguin breeding success at FISMP locations, 1993-2003 monitored at 1-2 locations and 2006-2020 monitored at 6–7 locations. (Solid line - annual average). Standard Error bars show error about the overall mean by site means, and do not incorporate error about individual sites.

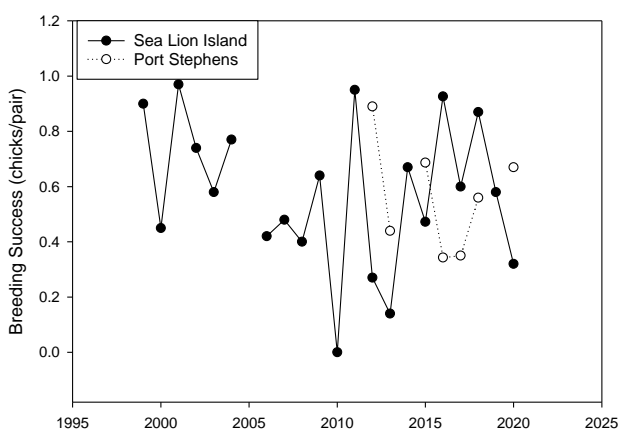
Breeding success varied between locations from a minimum of  $0.32 \pm 0.04$  chicks/pair at Sea Lion Island to a maximum of 0.87 chicks/pair at Bleaker Island. The largest changes in breeding success between 2019 and 2020 were seen at Steeple Jason Northwest with a 103 % increase, and at Sea Lion Island with a 45 % decrease (**Figure 23 to 25**).



**Figure 23:** Southern Rockhopper Penguin breeding success for locations in mainland East Falkland.



**Figure 24:** Southern Rockhopper Penguin breeding success for locations on Steeple Jason.



**Figure 25:** Southern Rockhopper Penguin breeding success for locations in south Falklands.

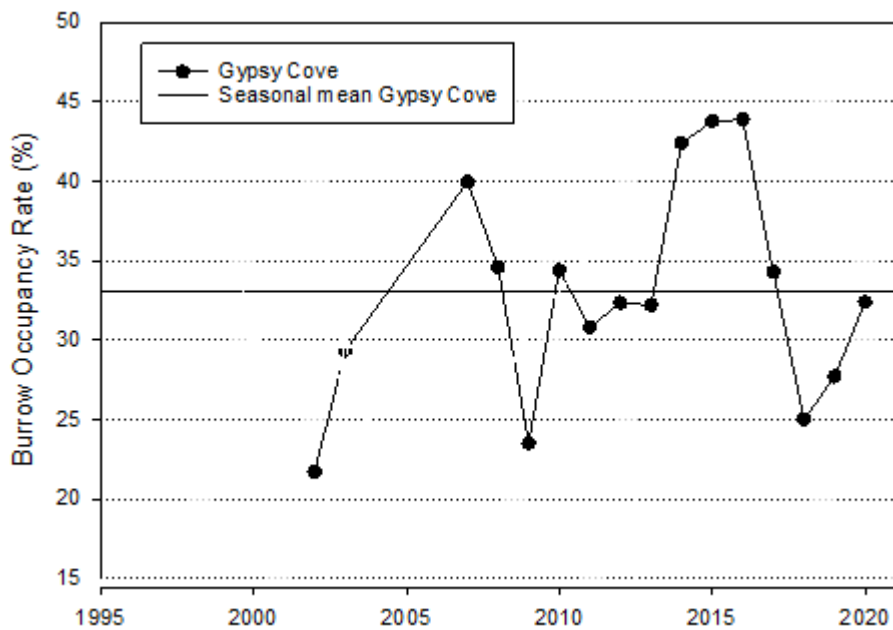
## Magellanic Penguin

The location and extent of transects and the estimated occupied burrow densities at Gypsy Cove are shown in **Figure 26**. Thirty transects were carried out between Engineer Point and the Car Park at Gypsy Cove, of which, half ( $n = 15$ ) contained occupied Magellanic Penguin burrows (yellow, orange, dark orange and red coloured bars on **Figure 26**). Burrow distribution was closely associated with tussac grass occurrence.

Where burrows occurred, estimated densities ranged from 6,750 to 48,866 occupied burrows /km<sup>2</sup>, with an average density of  $9,220 \pm 3,704$  /km<sup>2</sup> - slightly higher than the previous year of  $8,184 \pm 6,529$  /km<sup>2</sup>. Taking all burrows for which there was no uncertainty over occupancy status ( $n = 111$ ), as per surveys prior to 2012, gave an occupancy rate of 32.4 %. This occupancy rate was slightly below the seasonal average for the site (**Figure 27**).



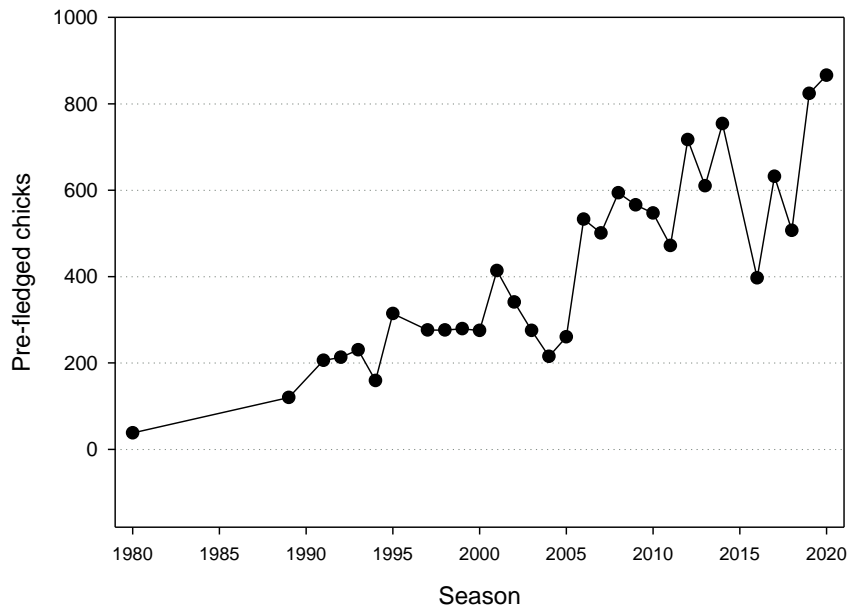
**Figure 26:** Transect locations for the Magellanic Penguin survey at Gypsy Cove, 2020 (image from Google Earth). Yellow ( $\geq 0$  and  $\leq 10,000$  breeding pairs/ $\text{km}^2$ ), light orange ( $> 10,000$  and  $\leq 20,000$  breeding pairs/ $\text{km}^2$ ), dark orange ( $> 20,000$  and  $\leq 30,000$  breeding pairs/ $\text{km}^2$ ) and red ( $> 30,000$  breeding pairs/ $\text{km}^2$ ) lines show minimum breeding pair densities between the shore and the furthest burrow from the shore; light grey lines show the extent of each transect where no burrows were present, dark grey lines where only unoccupied burrows were recorded.



**Figure 27:** Magellanic Penguin burrow occupancy rate at Gypsy Cove, 2002 -2020.

## King Penguin

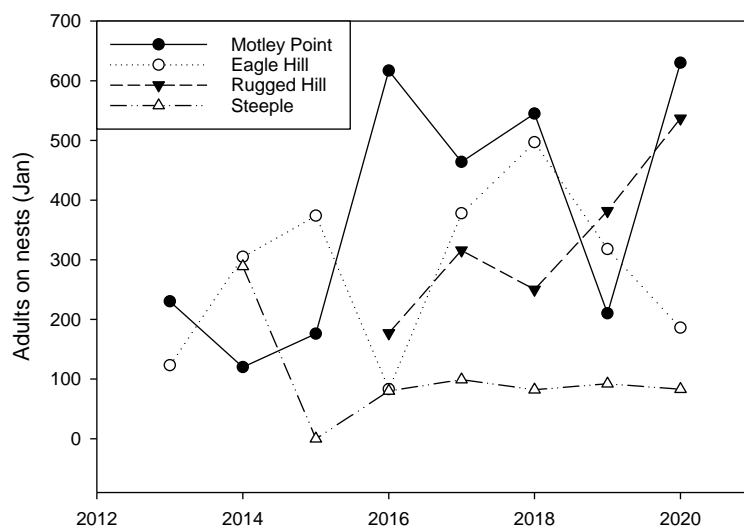
The number of pre-fledged chicks at Volunteer Point in November 2020 was 866, this was a 5 % increase from 824 chicks in 2019 (**Figure 28**). The numbers of pre-fledged chicks at Volunteer Point continues to show an overall increasing trend, despite intermittent fluctuations.



**Figure 28:** King Penguin pre-fledged chick numbers at Volunteer Point, 1980-2020.

## Imperial Shag

Imperial Shag monitoring was initiated in 2013 at two colonies and expanded to four colonies in 2016. Numbers of Adult on Nests (AON) of Imperial Shags were counted in January 2021; the results at the colonies continues to be variable over sites and seasons (**Figure 29**).

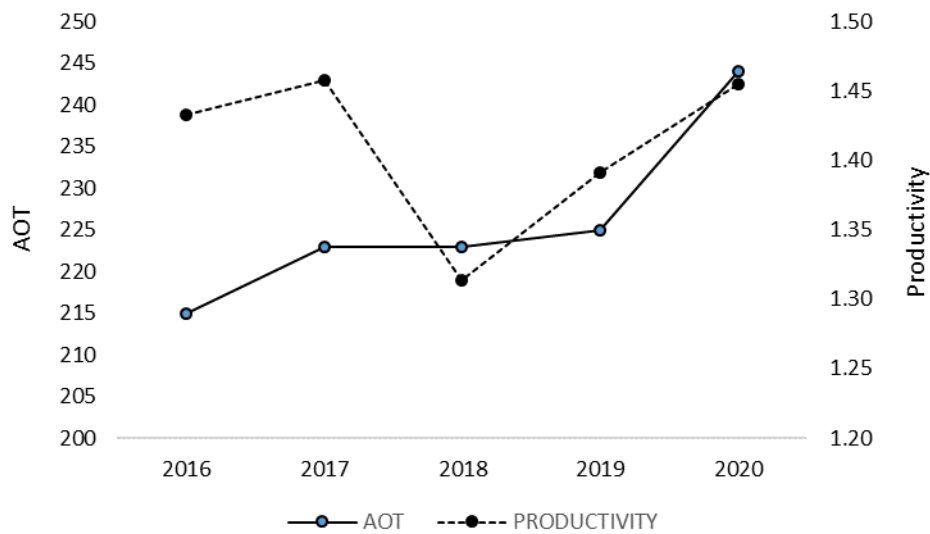


**Figure 29:** Imperial shag Apparently Occupied Nests (AON), 2013-2020.



## Brown Skua

With 244 Apparently Occupied Territories (AOT) counted in 2020 there was an increase (8 %) in the total numbers of Brown Skua AOT from 2019 at Steeple Jason. A broad measure of productivity (the ratio of eggs/chicks per adult territory) was 1.45. This was higher than recorded in 2019 (Figure 30). In 2020, of the site total, the Northwest colony had the largest number of AOT (43 %) followed by Neck (34 %), South (12 %), House (9 %) and South of Ridge (1%).



**Figure 30:** Brown Skua Apparently Occupied Territories (AOT) and productivity at Steeple Jason, 2016-2020.

# Black-browed Albatross

## Breeding pairs

The estimated number of breeding pairs of Black-browed Albatross at five of the Steeple Jason sites monitored since 2005 was 3,179 in 2020; this represented a 1 % decrease from 3,206 pairs in 2019 (Figure 31).

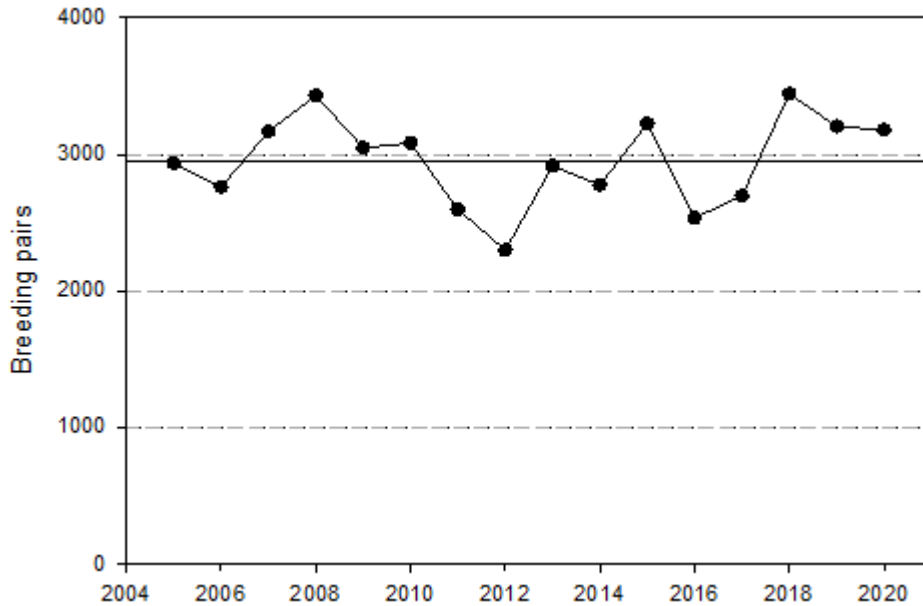


Figure 31: Black-browed Albatross breeding pairs at FIMSP sites, Steeple Jason, 2005-2020. (Solid line – annual average).

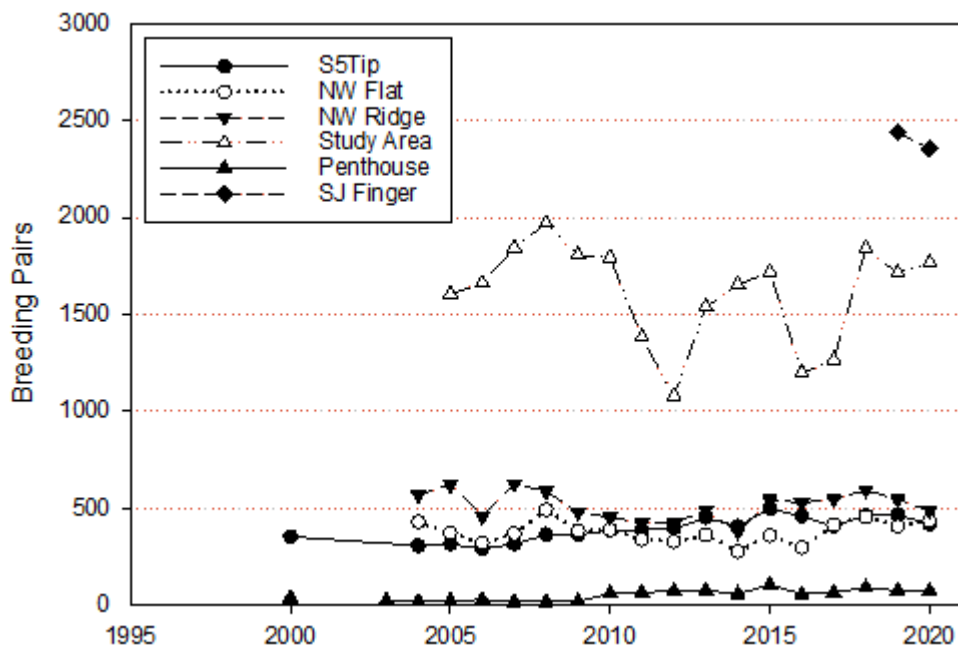


Figure 32: Black-browed Albatross breeding pairs at individual FIMSP sites at Steeple Jason, 2000-2020.

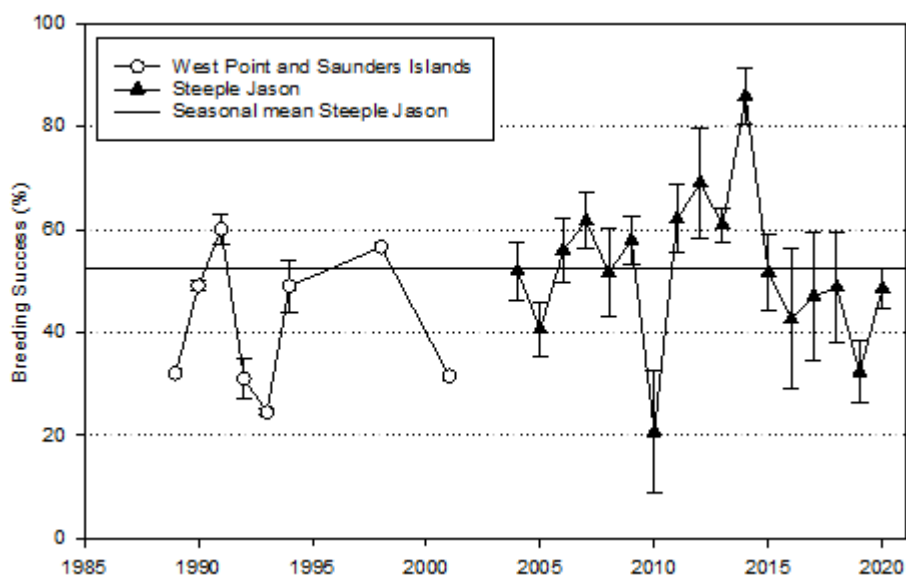
Steeple Jason Finger, added in 2019, is now the largest monitored colony with  $2,355 \pm 1.4$  breeding pairs in 2020, and demonstrated a small decrease of pair numbers (3 %) when compared with 2019. Three of the long-term monitored colonies at Steeple Jason also showed decreases in breeding pair numbers when compared with 2019; S5Tip (11 %), Northwest Ridge (10 %) and Penthouse (3 %). The NW Flat and Study Area showed small increases in breeding pairs at 7 % and 3 % respectively (**Figure 32**).

### **Breeding success**

Overall breeding success for the four long-term monitored colonies (excluding the Penthouse colony) was  $49 \% \pm 7.5$  chicks/pair in 2020 (**Figure 33**). Breeding success remained below the annual average (53 %) for the sixth consecutive year.

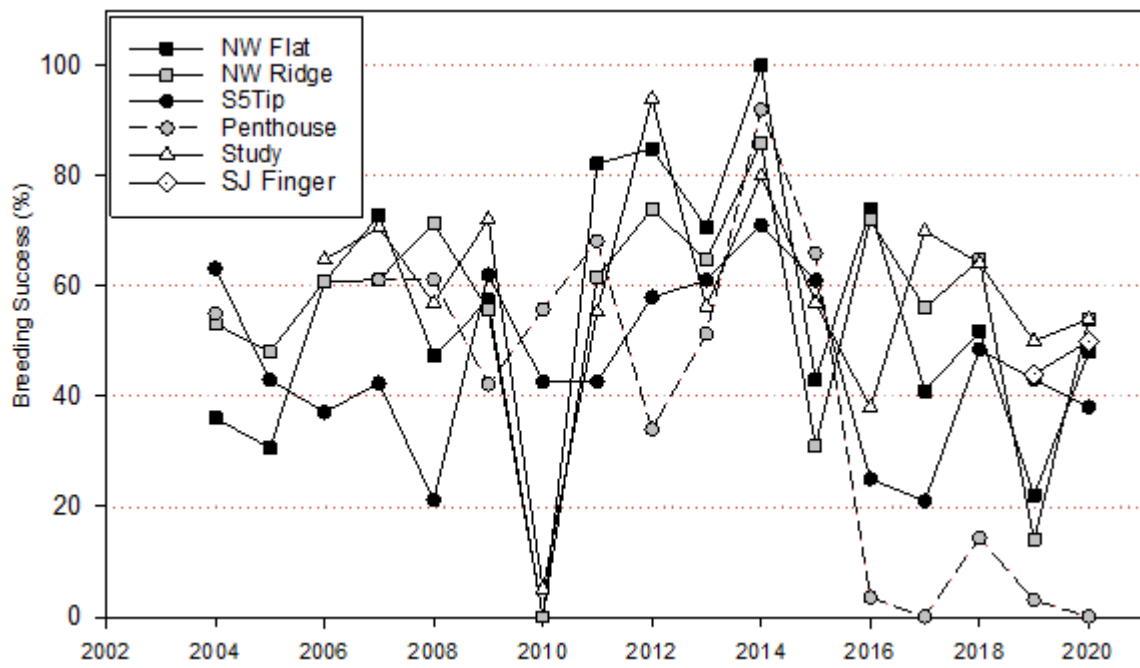
Breeding success was highly varied between the individual colonies; NW Ridge (54 %), SJ Finger (50 %), NW Flat (48 %), S5Tip (38 %) and the Penthouse (0 %) (**Figure 34**).

Breeding success at the Penthouse colony for the last 4 years has been notably low. In 2020 and 2017 the colony experienced complete breeding failure (0 %) and in 2016, 2018 and 2019 chick success was 3.5 %, 14 % and 3 % respectively (**Figure 34**).



**Figure 33:** Black-browed Albatross breeding success at FISMP sites on Steeple Jason, 2004-2020 (excluding Penthouse colony for all years) and West Point and Saunders Island, 1989-2001.

Standard Error bars show error about the overall mean by colony means and do not incorporate error about individual sites. (Solid line – annual average).



**Figure 34:** Black-browed Albatross breeding success at FIMSP locations on Steeple Jason, 2004-2020.

## Southern Giant Petrel

### Breeding pairs

The overall number of breeding pairs of Southern Giant Petrel at monitored colonies on Steeple Jason increased by 6 % from an estimated 1,771 pairs in 2019 to 1,854 pairs in 2020. The Neck colony increased by 17 %, whilst the NW colony decreased by 57 % when compared with 2019 (Figure 36).

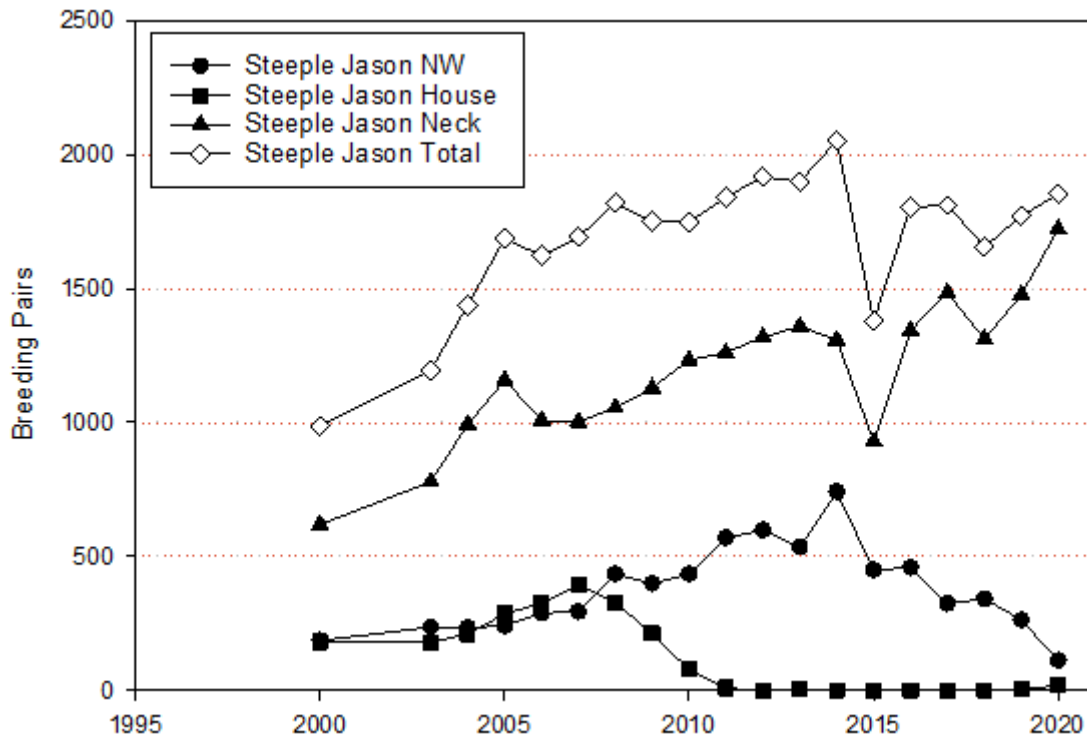
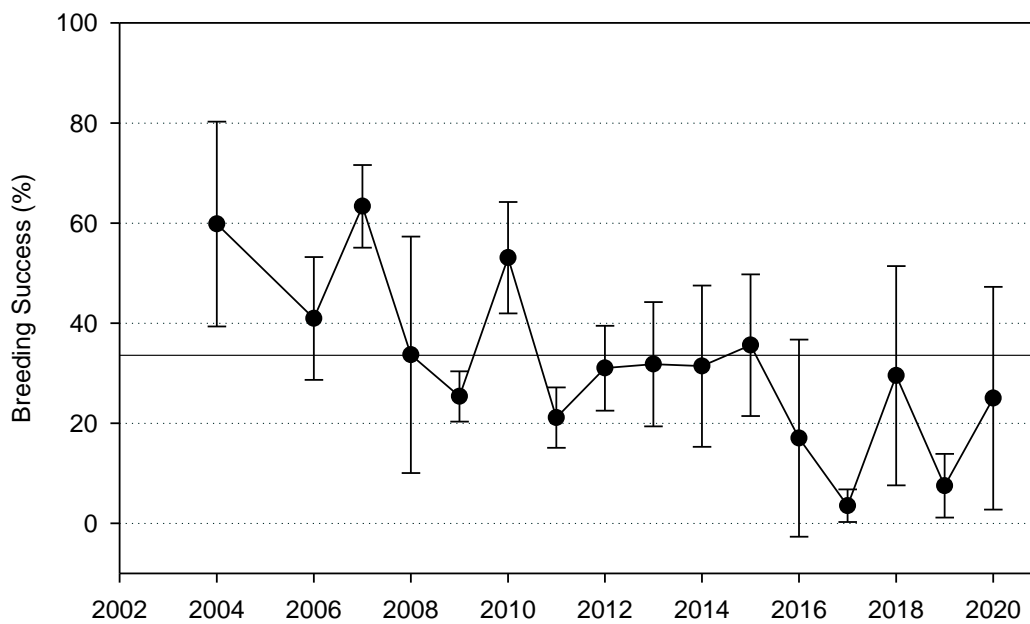


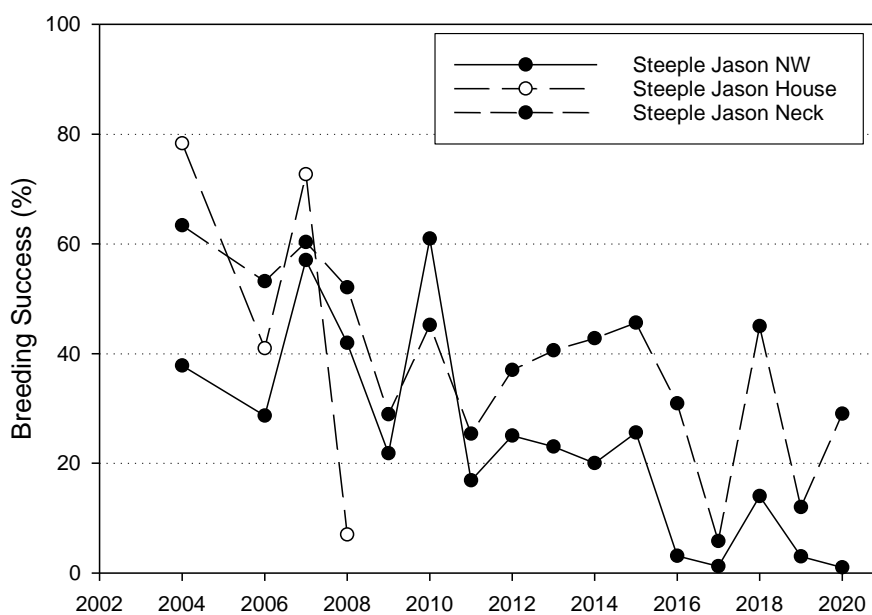
Figure 36: Southern Giant Petrel breeding pair numbers at FISMP sites on Steeple Jason, 2000-2020.

### Breeding success

In 2020, average breeding success of the two colonies at Steeple Jason was  $15 \pm 19.8\%$  (Figure 37). The Neck colony breeding success increased from 12 % in 2019 to 29 % in 2020, whilst the NW colony decreased from 3 % to 1 %; the latter was very near to complete breeding failure, the fourth time within five consecutive years (Figure 38). Overall breeding success for 2020 remained below the long-term annual average (32 %) for this site.



**Figure 37:** Southern Giant Petrel average breeding success at FISMP sites on Steeple Jason, 2004-2020. Standard Error bars show error about the overall mean by colony means and do not incorporate error about individual sites. (Solid line – annual average).

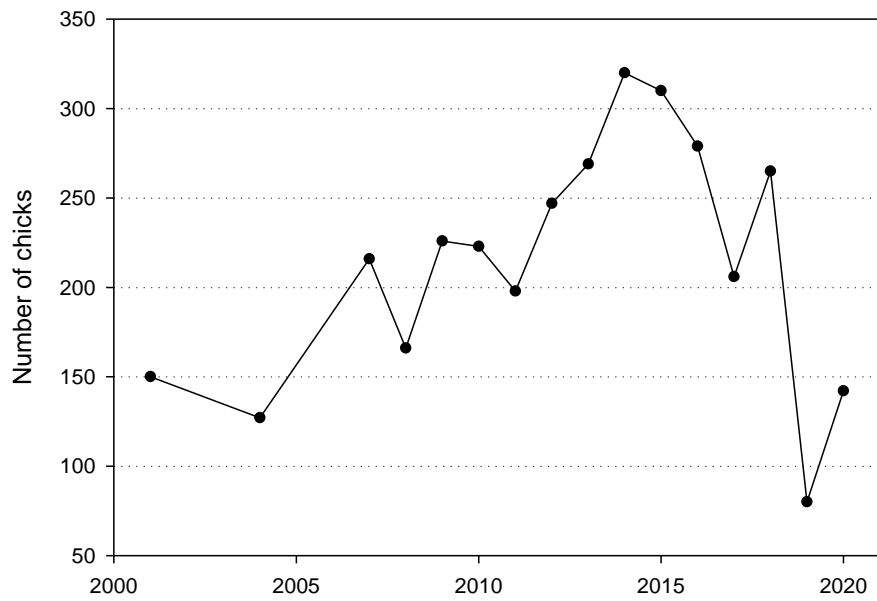


**Figure 38:** Southern Giant Petrel breeding success at FISMP sites on Steeple Jason, 2004-2020.

During 2020, six Southern Giant Petrel nests were observed from drone imagery near the Black-browed Albatross Northwest Flat colony; this is the seventh year that Southern Giant Petrel have nested in this area although all nests subsequently failed. A further twenty nests were observed along the Northwest track (the historic House colony) with nine pre-fledged chicks observed in April 2021.

***Bleaker Island pre-fledged chick count***

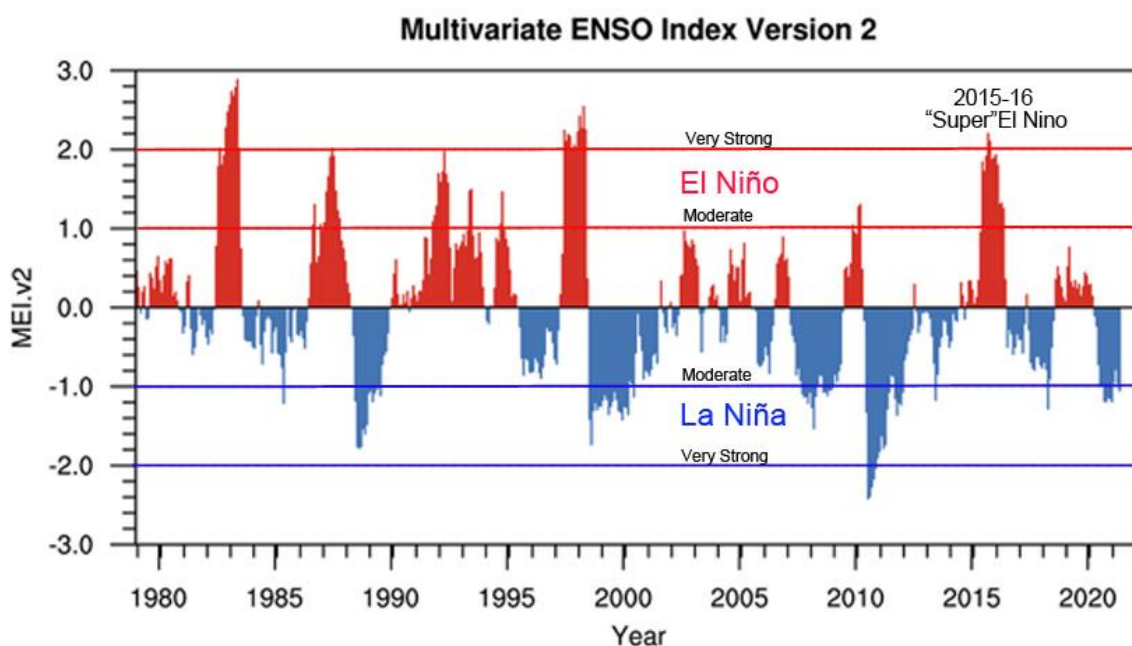
The number of Southern Giant Petrel chicks on Bleaker Island increased from 80 chicks in 2019 to 142 chicks in 2020 (**Figure 39**).



**Figure 39:** Southern Giant Petrel chick counts at Bleaker Island, 2001-2020.

## Environment

Neutral El Niño Southern Oscillation (ENSO) and La Niña conditions dominated the period of 2020 to 2021 (**Figures 40**). El Niño Southern Oscillation events (ENSO) and the subsequent opposite, La Niña, have major climatic impacts, especially on oceanic habitats, affecting breeding success of both land and seabirds. In 2015-16 a ‘Super’ El Niño event occurred and the FISMP subsequently detected a decline in breeding numbers of seabirds, particularly Gentoo and Southern Rockhopper Penguins. FIMSP monitoring between 2016 and 2020 revealed that the breeding pair numbers of both Gentoo Penguin and Southern Rockhopper Penguins have remained broadly static under subsequent fluctuating weak to moderate El Niño and El Niña conditions.



**Figure 40:** Multivariate ENSO Index

The multivariate ENSO index, abbreviated as MEI, is a method used to characterize the intensity of a Southern Oscillation (ENSO) event. Given that ENSO arises from a complex interaction of a variety of climate systems, MEI is regarded as the most comprehensive index for monitoring ENSO since it combines analysis of multiple meteorological and oceanographic components.

## Anthropogenic and other impacts at colonies

### Marine plastic

Marine plastic was observed at the Steeple Jason Black-browed Albatross NW Ridge and Study Area, and the Gentoo Penguin colony at Lagoon Sands. Items included: blue plastic sheeting (commercial fishing boat); various ropes/ twines (vessel) and plastic drinking bottles either near to, or built within nests. For full details see **Appendix 6**.



**Oiling**

No oiled birds were observed at the FISMP sites in 2020

**Marine entanglements**

No marine entanglements were observed at the FISMP sites in 2020

**Disease**

Towards the end of the 2020 season (February-March) Avian Pox in Gentoo Penguin was reported, and subsequently confirmed (APHA Laboratories, UK), at one site to the west and one site to the south of the Falklands.

## Discussion

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### ***Gentoo Penguin: IUCN status: Least Concern (2018)***

*Falkland Islands breeding pair estimate: 132,321 ± 2,015 in 2010 (30 % of global population)*

*The FISMP 2020 annual change in breeding pair numbers: Decrease (6 %)*

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The 2020 estimated numbers of breeding pairs of Gentoo Penguin at the FISMP sites showed a 6 % decrease when compared with the previous year, and continued to represent a major reduction (36 %) from the most recent breeding pair maximum estimate recorded in 2015. The 2020 breeding performance was above the FISMP long-term annual average and had improved year on year from 2017.

The overall FISMP trend showed a steady increase of breeding pair numbers between 2003 and 2015 and reflecting an island-wide increase (105 %) between 2005 and 2010 (Baylis et. al 2013a). In 2016, FISMP reported a notable decrease in breeding pair numbers, likely (at least partially), due to birds choosing to defer breeding under the unfavourable environmental conditions during a period that coincided with a strong El Niño Southern Oscillation event (Crofts & Stanworth 2017). In 2017 a partial recovery in breeding numbers was likely explained by birds re-entering the breeding population as environmental conditions had improved. However, current estimates show no clearly defined recovery period in breeding pair numbers since 2017. An unknown, but probably significant, proportion of the adult and juvenile population were likely permanently lost through mortality in 2016.

Globally, the Gentoo Penguin population have been growing, particularly along the Western Antarctic Peninsula (Herman et al. 2020), with the Falklands comprising 30 % of the estimated global population in 2010. As Gentoo Penguins at the Falkland Islands are resident all year around and remain within the Falkland waters, localised parameters are reflected by the strong regional variability of colony trends. In the northeast of the Islands, Volunteer Green and Cow Bay colonies continue to show a less fluctuating more positive trajectory (aside from the 2016 drop which affected most colonies markedly). Colonies in the south and east appear prone to more regular and larger fluctuations.

The potentially complex influences of oceanographic parameters affecting prey availability on breeding pair numbers (Baylis et al. 2011; Handley et al. 2016), as well as disease and predation incidence may contribute to this regional variability, and indicate that some colonies more than

others may be vulnerable to declines. Gentoo Penguins exhibit adaptive traits including more flexibility in breeding phenology, a high reproductive output with an early onset of breeding maturity around the age of 3 years, and in a fluctuating environment these traits are likely to offer some resilience and ability to recover from population declines (Pistorious et al. 2010). Overall breeding performance of Gentoo Penguins at FISMP sites, had improved year on year from 2017 to 2020, a positive indication for the potential increase in numbers of young adults entering into the breeding population in the upcoming seasons.

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***Southern Rockhopper Penguin: IUCN status: Vulnerable (2018)***

*Falkland Islands breeding pair estimate: 319,163 ± 24,820 in 2010 (36 % of global population)*

*The FISMP 2020 annual change in breeding pair numbers: Decrease (1 %)*

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The estimated number of breeding pairs of Southern Rockhopper Penguin decreased marginally by 1 % from the 2019 estimate. This continued to represent a substantially lower population estimate (29 % down) from the most recent breeding pair maximum estimate recorded in 2015.

The overall trend in estimated breeding pair numbers showed a steady increase over 12 seasons, reaching a peak in 2015 before a significant drop in 2016 and a plateau from 2017 to 2020. During March 2016, Southern Rockhopper Penguin mortality (due to starvation during the moult period) was recorded at the Falklands (Crofts & Stanworth 2016, Morgenthaler et al. 2018), and an overall decrease of 31 % in breeding numbers was recorded at the FISMP sites at the start of the next breeding season. Current estimates show no clearly defined recovery in breeding pair numbers at this point. It is unknown what the level of mortality was during 2016, and as with Gentoo Penguins, breeding deferral is reported in *Eudyptes* penguins (Crawford et al. 2006). However, the FISMP data, and lack of evidence of recovery therein, suggests that significant numbers of breeding individuals had been permanently lost to the population at the Falklands Islands, and most likely at a larger regional scale (Morgenthaler et al. 2018). The closest colonies of Southern Rockhopper Penguins to the Falklands are Isla de los Estados, Tierra del Fuego (approx. 140,000 breeding pairs in 2010; Reya Rey et al. 2014) and Isla Pingüino, Santa Cruz (1200 breeding pairs in 2015; Gandini et al. 2015). Despite an observed reduction in numbers at Isla Pingüino after the starvation event (Morgenthaler et al. 2018), there have been no further population estimates since at these sites. Considering the breeding strategy of this species, with maturity reached from 4 years and onwards of age, with typically only 1 out of a possible 2 chicks raised, and coupled with changes in

oceanographic processes that negatively impact on sensitive periods such as the pre-moult, retention of its status as the only IUCN Vulnerable listed seabird at the Falklands remains. Continued and broader monitoring (i.e. Falkland Island-wide) is critical to understand the population trajectory in the upcoming seasons.

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***Magellanic Penguin: IUCN status: Least Concern (2020)***

*Falkland Islands breeding pair estimate: 76,000 – 142,000 (1997) (<10 % of global population)*

*The FISMP 2020 annual change in burrow occupancy rate: Increase (14.7 %)*

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At Gypsy Cove in 2020, breeding Magellanic Penguin burrow occupancy remained associated with the extent of tussac grass habitat. The 2020 occupancy rate of 32.4 % had increased from the previous year (27.7 %), and was just below the annual average (33.0 %). Although burrow density data have only been collected since 2012, there is no indication from this data set that burrow density is decreasing at the survey site over time. Hence, this broadly supports burrow occupancy as a good proxy for breeding pair trends at the site. Globally this species is considered to be exhibiting declines (Birdlife International 2020); however, in spite of occupancy rate fluctuations at Gypsy Cove there is no indication of declines in the resident population. How much this site reflects trends at other sites for this species in the Falkland's remains unknown.

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***King Penguin: IUCN status: Least Concern (2018)***

*Falkland Islands breeding pair estimate: 1000-1500 (<1 % of global population)*

*The FISMP 2020 annual change in chick numbers: Increase (5 %)*

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In November 2020 the number of pre-fledged chicks at Volunteer Point was 866, an increase of 5 % when compared with 2019, and the highest value recorded since monitoring began in 1980. The large global population of King Penguins (1 million annual breeding pairs) is thought to be stable (BirdLife International 2021), with the relatively small Falklands' population occupying the northern limits of the global range for this species. The long-term monitoring at Volunteer Point showing an overall steady increasing population may reflect either increased immigration (i.e. from the large population at South Georgia) and/or improved feeding conditions (Pistorious et al. 2012). Conversely, the population of King Penguins along the northern limits at Crozet Islands (Southern Indian Ocean) have reportedly declined by more than 88 % over the last 35 years (Weimerskirch et al. 2018).

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***Black-browed Albatross: IUCN status: Least Concern (2018)***

*Falkland Islands breeding pair estimate: 475,000-535,000 in 2010 (72 % of global population)*

*The FISMP 2020 annual change in breeding pair numbers: Decrease (1 %)*

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The overall breeding pair numbers of Black-browed Albatross at Steeple Jason monitoring sites in 2020 showed a decrease of 1 % when compared with 2019. Given the annual fluctuations, the overall FISMP trend continued to suggest a currently stable population at these monitored colonies. The overall breeding success in 2020 remained below the annual average for the sixth consecutive year.

The Falkland Islands hold 72 % of the global breeding population of Black-browed Albatrosses with Steeple Jason the largest global breeding site. The overall Falkland Islands population has shown an increase in breeding pair numbers between 2005 and 2017 (FC data in prep.), including at Steeple Jason. In 2019, a new colony (S5 Finger), where expansion of the colony is not limited, was added to the FISMP to improve the annual monitoring in capturing the broader population trend at Steeple Jason.

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***Southern Giant Petrel: IUCN status: Least Concern (2018)***

*Falkland Islands breeding pair estimate: 20,970 ± 180 pairs in 2015 (43 % of global population)*

*The FISMP 2020 annual change in breeding pair numbers: Increase (6 %)*

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Overall breeding pair numbers of Southern Giant Petrel at Steeple Jason increased by 6 % from the previous year. In spite of notable changes in breeding pair numbers at individual colonies at Steeple Jason, including the complete decline of the House colony in 2011, the overall number of pairs has steadily increased over the monitoring period. In 2020, breeding resumed at the House colony, whilst the Northwest colony has declined steadily since 2015. It is difficult to account for the re-distribution of pairs at Steeple Jason, and although the species is highly susceptible to disturbance, changes do not appear to align with any potential human activity.

The breeding performance at Steeple Jason in 2020 was low. In 2004, the mean breeding success was 59.8 % whereas in 2020 it was 15 ± 19.8 %. An apparent long-term decreasing trend in breeding success at Steeple Jason is of concern for this site. An increasing breeding population and decreasing breeding success may point to limitations in food availability, given the species is a central

place forager and other large colonies also exist on adjacent Islands; however, the actual cause is unknown.

As the Southern Giant Petrels breeding at the Falkland Islands represent 43 % of the global population (Stanworth and Crofts 2017), continuation of declines in breeding success at Steeple Jason (representing around 8 % of the Falklands breeding population) would be of international concern. Opportunities to assess breeding performance at a broader scale for the Falklands' population would be beneficial, as this may be a site specific issue.

### **Anthropogenic and other impacts at colonies**

Marine plastics were recorded when they were either buried in or very close to the nests of seabirds. In 2020 new debris was recorded at the Gentoo Penguin colony at Lagoon Sands. The most common type of marine plastics found were plastic bottles, blue packaging/sheets, and plastic strapping bands; most items recorded were those commonly associated with commercial fishing vessels (**Appendix 6**).

Although in-depth disease screening is not within the current scope of the FISMP, highlighting factors that may be contributing towards seabird breeding performance at an island-wide scale is important to the context of the FISMP results. In March 2021, two Gentoo Penguin colonies in the Falklands were confirmed to have avian pox. In-depth details are recorded separately to the FISMP.

## Acknowledgements

The continuation of the FISMP is dependent on access to seabird colonies. Falklands Conservation would like to thank the many landowners/managers who have allowed us to conduct fieldwork on their land, including the Wildlife Conservation Society, Falkland Islands Government, Sea Lion Island, Port Stephens, Fitzroy, Race Point, Johnsons Harbour, Goose Green, Walker Creek and North Arm. We thank Michael McRae and Nikki Summers, Derek and Trudi Pettersson, and Rob and Lorraine McGill for logistical support and the many volunteers who participated in data collection, particularly Mike Morrison for his long-standing support. We would also like to thank the landowners at Dunbar (Hugues and Marie-Paul Delignieres) and Bleaker Island (Mike, Phyl and Nick Rendell) for providing their survey data and allowing it to be included within the report. Lastly, thanks to Emmaleigh Middleton and Emma Harte for helping to count seabirds from drone images.

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## Appendix 1: Count information

Location	Date of breeding pair count	Counters	Date of chick count	Counters
Volunteer Green	19/11/2020	S. Crofts M. Tierney	08/01/2021	S. Crofts D. Higgins
Race Point	17/11/2020	S. Crofts M. Tierney	11/01/2021	S. Crofts M. Winnard
Sea Lion Island	12/11/2020	M. Morrison	09/01/2021	M. Morrison
New Haven	06/11/2020	A. Stanworth P. Jelbes, D. Proud	15/01/2021	A. Stanworth S. Stashynsky, S. P-Robertson
Bull Roads & Bull Point	03/11/2020	A. Stanworth P. Jelbes, D. Proud	12/01/2021	A. Stanworth S. Stashynsky, S. P-Robertson
Cow Bay	19/11/2020	S. Crofts M. Tierney	08/01/2021	S. Crofts D. Higgins
Low Bay	04/11/2020	A. Stanworth P. Jelbes, D. Proud	13/01/2021	A. Stanworth S. Stashynsky, S. P-Robertson
Motley Point	05/11/2020	A. Stanworth P. Jelbes, D. Proud	14/01/2021	A. Stanworth S. Stashynsky, S. P-Robertson
Bertha's Beach	08/11/2020	M. Morrison	06/01/2021	M. Morrison
Fox Point	08/11/2020	M. Morrison	06/01/2021	M. Morrison
Pleasant Roads	07/11/2020	M. Morrison	04/01/2021	M. Morrison
Steeple Jason	02-09/11/20	S. Crofts M. Tierney A. Pollard	Gentoo and Rockhopper 18-21/01/21. Black-browed and Giant Petrel 01-04/04/21	S. Crofts M. Winnard, S. Alazia A. Stanworth, M. Anstee E. Harte, A. P. Jelbes
Lagoon Sands	19/11/2020	S. Crofts M. Tierney	08/01/2021	S. Crofts D. Higgins
Diamond Cove	20/11/2020	S. Crofts M. Tierney	06/01/2021	M. Tierney
Rugged Hill/Eagle Hill	20/11/2020	S. Crofts M. Tierney	09/01/2021	S. Crofts
Port Stephens	27/10/2020	S. Crofts T. Stenning	13/01/2021	S. Crofts
Penguin Point South		Not done		Not done
Bleaker Island	Gentoo – 10/11/2020 Rockhopper – 25/11/2020	N. Rendell N. Rendell	Giant Petrel 25/02/2021	M. Rendell N. Rendell
Gypsy Cove	04/12/2020	A. Stanworth H. Jeffrey, R. Irvine D. Blake, M. Winnard		

## Appendix 2: Gentoo Penguin count data

Location	Colony	Grid Ref.	Breeding Pairs (Mean±1SD)		Breeding Success (Mean±1SD)	
			Count	Count Type*	Count	Count Type*
Bertha's Beach	Bertha's Beach	-51.882233 -58.358916	506 ± 2	TR	1.14 ± 0.01	TR
Bull Point	Bull Roads	-52.309364 -59.398188	554 ± 21	TR	1.34 ± 0.04	D
Bull Point	Bull Point	-52.342591 -59.321461	1028 ± 6	D	0.84 ± 0.02	TR
Fox Point	Fox Point	-58.45 -51.92	381 ± 10	TR	1.15 ± 0.03	TR
Low Bay	Low Bay	-52.077608 -58.879630	324 ± 7	TR	1.36 ± 0.04	TR
Motley Point	Motley Point	-52.108576 -58.643177	1250 ± 29	TR	1.26 ± 0.03	TR
New Haven	New Haven	-51.742073 -59.222044	480 ± 3	TR	1.4 ± 0.03	TR
Pleasant Roads	Pleasant Roads	-51.83 -58.24	201 ± 1	TR	1.31 ± 0.01	TR
Race Point	Fanning Harbour	-51.464667 -59.087958	157 ± 2	TR	1.07 ± 0.08	TR
Race Point	Rookery Sands	-51.434122 -59.106928	889 ± 1	D	0.8 ± 0.02	D
Sea Lion Island	Sea Lion Island	-52.426578 -59.072513	3872 ± 17	TR	1.25 ± 0.01	TR
Steeple Jason	House	-51.02018 -61.233113	2287 ± 4	D	0.79 ± 0.01	D
Steeple Jason	Neck	-51.034787 -61.214888	3201 ± 6	D	0.8 ± 0.01	D
Johnsons Harbour	Cow Bay	-51.428572 -57.879051	1926 ± 3	D	1.29 ± 0.01	D
Johnsons Harbour	Lagoon Sands	-51.513702 -57.77581	796 ± 4	D	1.13 ± 0.01	D
Johnsons Harbour	Volunteer Green	-51.478494 -57.837858	1781 ± 18	TR	1.21 ± 0.02	GP

\* TR – Tally Repeated, TA – Tally Agreed, GP – Go Pro image count, D – Drone image count

### Appendix 3: Southern Rockhopper Penguin count data

Location	Colony/Sub-colony	Grid Ref.	Breeding Pairs (Mean ± 1 SD)	Count Type*	Breeding Success (Mean ± 1 SD)	Count Type*
Berkeley Sound	Diamond Cove	-51.538059 -57.923512	139 ± 0	TA	1.08 ± 0.01	TR
	Eagle Hill East	-51.544064 -57.785118	112 ± 0	TA	0.97 ± 0.03	TR
	Eagle Hill	-51.544497 -57.802981	792 ± 7	D	0.65 ± 0.06	TR
	Eagle Hill West	-51.545082 -57.810499	833 ± 7	D/TR	0.72 ± 0.01	D
	Rugged Hill East	-51.543674 -57.845031	410 ± 6	TA	1.22 ± 0.02	TR
	Rugged Hill	-51.5432 -57.85185	450 ± 8	D	0.82 ± 0.02	D
	Rugged Hill West	-51.543488 -57.851570	324 ± 0	D	0.98 ± 0.01	D
Port Stephens	Stephen's Peak	-52.133803 -60.859281	1292 ± 12	TR	0.67 ± 0.01	TR
Race Point	Fanning Head North	-51.460831 -59.141540	251 ± 8	TR	0.62 ± 0.08	TR
	Fanning Head South	-51.469284 -59.137749	355 ± 4	TR	0.65 ± 0.02	TR
Sea Lion Island	Rockhopper Point	-52.446667 -59.115501	374 ± 12	TR	0.32 ± 0.04	TR
Steeple Jason	Northwest Flat	-51.012810 -61.252682	106 ± 3	DR	0.57 ± 0.03	TA
	Northwest Ridge	-51.012939 -61.252884	97 ± 0	TA	0.61 ± 0	TA
	S5Tip	-51.037932 -61.220460	787 ± 7	D	0.51 ± 0	TA
	South East	-51.046215 -61.206635	684 ± 1	TA	0.56 ± 0	TA
	S5Finger	-51.031884 -61.231434	1012 ± 13	D	0.54 ± 0.01	TA

\* TR – Tally Repeated, TA – Tally Agreed, GP – Go Pro image count, D – Drone image count

## Appendix 4: Magellanic Penguin survey data

Transect	Number of Burrows	Number of occupied burrows	Distance to last burrow (m)	Minimum Pair Density per Km <sup>2</sup>
T1	0	0	0	0
T2	0	0	0	0
T3	0	0	0	0
T4	0	0	0	0
T5	4	2	49.14	10175
T6	8	4	43.4	30722
T7	0	0	0	0
T8	0	0	0	0
T9	1	0	10.74	0
T10	0	0	0	0
T11	0	0	0	0
T12	0	0	0	0
T13	8	1	49.38	6750
T14	12	5	41.54	40122
T15	0	0	0	0
T16	12	2	61.72	8838
T17	5	3	48.2	25934
T18	0	0	0	0
T19	2	1	20.53	24355
T20	0	0	0	0
T21	0	0	0	0
T22	0	0	0	0
T23	1	1	22.16	11282
T24	32	8	104.33	19788
T25	15	2	87.08	9570
T26	16	4	43.52	22978
T27	9	1	46.2	9740
T28	5	1	12.79	48866
T29	6	1	33.38	7490
T30	0	0	0	0

## Appendix 5: Black-browed Albatross and Southern Giant Petrel count data

### *Black-browed Albatross*

Sub-colony		Breeding Pairs (Mean $\pm$ 1 SD)	Count Type*	Breeding Success (chicks/pair) (Mean $\pm$ 1 SD)	Count Type*
Study Area Colony	-51.046 -61.207	1768 $\pm$ 2	TR	0.54 $\pm$ 0	TA
SSTip	-51.037 -61.220	417 $\pm$ 2	D	0.38 $\pm$ 0.03	DR
Penthouse	-51.031 -61.228	72 $\pm$ 0	TA	0	TA
Northwest Flat	-51.012 -61.252	434 $\pm$ 7	D	0.48 $\pm$ 0.02	D
Northwest Ridge	-51.012 -61.252	488 $\pm$ 3	TR	0.54 $\pm$ 0.02	D
SSFinger	-51.031 -61.231	2355 $\pm$ 1	D	0.50 $\pm$ 0.01	D

\* TR – Tally Repeated, TA – Tally Agreed, GP – Go Pro image count, D – Drone image count

### *Southern Giant Petrel*

Colony		Breeding Pairs (Mean $\pm$ 1 SD)	Count Type*	Breeding Success (chicks/pair) (Mean $\pm$ 1 SD)	Count Type*
Neck	-51.042 -61.206	1722 $\pm$ 19	D	0.29 $\pm$ 0.02	D
Northwest (South of Ridge)	-51.024 -61.248	112 $\pm$ 2	TR	0.01 $\pm$ 0.02	TR
House (Northwest track)	-51.017 -61.241	20 $\pm$ 0	TA	0.45 $\pm$ 0	TA
Northwest Flat	-51.012 -61.251	6 $\pm$ 0	TA	0	TA

\* TR – Tally Repeated, TA – Tally Agreed, GP – Go Pro image count, D – Drone image count

## Appendix 6: Marine plastics at FISMP sites

Serial	Nest	Date	FISMP site	Species	Debris type	Position of debris
1	1	05/11/2019	Steeple Study	BBA	1 litre plastic drinking bottle	Next to nest
1	2	05/11/2019	Steeple Study	BBA	1 litre plastic drinking bottle	Next to nest
3	3	05/11/2019	Steeple Study	BBA	1 litre plastic drinking bottle	Next to nest
4	4	05/11/2019	Steeple Study	BBA	1 litre plastic drinking bottle	Next to nest
5	5	05/11/2019	Steeple Study	RHP	1 litre plastic drinking bottle	Next to nest
6	6	06/11/2019	Steeple Study	BBA	2 litre plastic drinking bottle	Next to nest
7	6	06/11/2019	Steeple Study	BBA	1 500 ml plastic drinking bottle (coca cola)	Next to nest
8	6	06/11/2019	Steeple Study	BBA	Polystyrene sheet 30x30cm	Next to nest
9	7	06/11/2019	Steeple Study	BBA	Plastic Blue bottle (other) <500ml	Next to nest
10	8	06/11/2019	Steeple Study	BBA	1 litre Plastic Yellow bottle (other)	Next to nest
11	9	09/11/2019	Steeple NW Ridge	BBA	Plastic blue sheeting	Built into nest
12	10	09/11/2019	Steeple NW Ridge	BBA	Plastic blue sheeting	Next to nest
13	11	09/11/2019	Steeple NW Ridge	BBA	Green plastic twine	Built into nest
14	12	09/11/2019	Steeple NW Ridge	BBA	Plastic blue sheeting	Built into nest
15	13	09/11/2019	Steeple NW Ridge	BBA	Plastic blue foam piece	Built into nest
16	14	09/11/2019	Steeple NW Ridge	BBA	Plastic blue sheeting	Built into nest
17	15	05/11/2018	Steeple NW Ridge	BBA	Plastic blue sheeting	Built into nest
18	16	05/11/2018	Steeple NW Ridge	BBA	Plastic blue sheeting	Built into nest
19	17	09/11/2019	Steeple NW Ridge	BBA	Plastic bottle	Next to nest
20	18	09/11/2019	Steeple NW Ridge	BBA	Plastic bottle	Next to nest
21	19	09/11/2019	Steeple NW Ridge	BBA	Blue fishing line/nylon	Built into nest
22	20	08/01/2021	Lagoon Sands	Gentoo	Pile of strapping bands	Next to nest
23	21	08/01/2021	Lagoon Sands	Gentoo	Green string	Built into nest
24	22	08/01/2021	Lagoon Sands	Gentoo	Black piping	Next to nest
25	23	08/01/2021	Lagoon Sands	Gentoo	Green string	In colony
26	24	08/01/2021	Lagoon Sands	Gentoo	Green piece mesh	Built into nest
27	25	08/01/2021	Lagoon Sands	Gentoo	Plastic misc. small	In colony