



Falkland Islands Seabird Monitoring Programme

Annual Report 2021/2022 (SMP29).

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Summary

The Falkland Islands support seabird populations that are of global importance; both numerically and in terms of conservation status. Fluctuations in local populations will likely affect the global conservation status of these species. Falklands Conservation set up the Falkland Islands Seabird Monitoring Programme (FISMP) in 1989 which provides information on breeding population trends and breeding success for a number of important seabird species in the Falkland Islands. This report updates the Programme with data from the 2021/22 season.

Overall

Data indicate generally stable or stable-increasing breeding populations in the majority of FISMP species over their respective monitoring periods. Inter-annual fluctuations in breeding populations and breeding success can appear high; however, longer-term, larger, multi-season, repeating oscillations of decline and recovery are clearly also evident in some species. Populations of other FISMP species may yet exhibit similar large-scale oscillating trends with longer monitoring. Understanding such longer-term, larger scale, population characteristics is critical in identifying genuine circumstances for conservation concern. The apparent long-term, consistent decline in breeding success of Southern Rockhopper Penguin is such a circumstance. Most FISMP species appeared to respond to the strong El Niño event in 2014/2015/2016, with inflexions in trends in estimated breeding population size or breeding success, or both. Climate change mediated environmental conditions are likely to continue to be a significant influence on seabird populations.

Gentoo Penguin

Breeding population: sites **down 3.1 %** on 2020; FISMP overall trend - fluctuating, **stable-increasing**

Breeding success: sites **down 6.2 %** on 2020; FISMP overall trend - fluctuating, **stable / stable-increasing**

The Gentoo breeding population index has been in decline since 2015 but remains within the range of historic fluctuations and still presents an overall stable-increasing trend over the last 34 years.

Southern Rockhopper Penguin

Breeding population: sites **down 0.8 %** on 2020; FISMP overall trend: fluctuating, **stable**

Breeding success: sites **down 15.0 %** since 2020; FISMP trend: **long-term declining**

The Southern Rockhopper Penguin breeding population index has declined since 2015 but remains within the range of historic fluctuations and currently still presents a likely overall stable trend over the last 30 years. However, continued long-term declines in breeding success are a notable concern.

King Penguin

King penguin pre-fledged chicks were not monitored in 2021 as part of the FISMP; however, a count provided by a site warden gave indication of further increases on the 2020 count, perpetuating a **long-term positive trend** at the site over the last 40 years.

Imperial Shag

Imperial Shag numbers continued to fluctuate seasonally at monitored sites; however, a general **decrease** in estimated breeding pairs in January at each monitoring site may be emerging.

Black-browed Albatross

Breeding population: sites **up 2.5 %** on 2020; FISMP overall trend: **increasing**

Breeding success: sites **down 29.2 %** on 2020; FISMP overall trend: **decreasing**

The breeding population index fitted trend for Steeple Jason (the largest site globally for the species and 36% of the national population) indicates a steadily increasing breeding population trend over the last 20 years. A steadily increasing trend in breeding success from 2000 became a notable decreasing trend around 2014, which remains in place in 2021.

Southern Giant Petrel

Breeding population: sites **up 2.4 %** on 2020; FISMP overall trend: **stable-increasing**

Breeding success: sites **up 24.0 %** on 2020; FISMP overall trend: **stable-increasing after long decline**

No clear trend is evident in the estimated breeding population data for Steeple Jason (around 8 % of the national population); however, indications are of a generally increasing population that like other seabirds in the Island's was negatively impacted during 2014/15, 2015/16. A longer-term decline in breeding success appears to have reversed during the same time with current indications of an upward trend.

Magellanic Penguin

Burrow occupancy at Gypsy Cove was broadly associated with the extent of tussock grass habitat. In 2021 there was a burrow occupancy rate of 18.7 %, which was the **lowest on record** since surveying began in 2002. Data from all FISMP sites indicate a **stable / stable-declining** occupancy rate over the monitoring period.

Brown Skua

Numbers of Apparently Occupied Territories (AOT) at Steeple Jason were not monitored in 2021.

Previous data indicate an **increasing** population trend for the site.

Introduction

The Falkland Islands support significant seabird populations, including those of global importance, both numerically, and in terms of conservation status. These include:

- An estimated 72 % of the global population of Black-browed Albatross (*Thalassarche melanophris*) (IUCN Red Listed as 'Least Concern', BirdLife International 2018);
- An estimated 43 % of the global population of Southern Giant Petrel (*Macronectes giganteus*) (Red Listed 'Least Concern', BirdLife International 2018);
- An estimated 30 % of the world's population of Gentoo Penguin (*Pygoscelis papua*) (IUCN Red Listed as 'Least Concern', BirdLife International (2020);
- An estimated 36 % of the world's population of Southern Rockhopper Penguin (*Eudyptes c. chrysocome*) (IUCN Red Listed as 'Vulnerable', BirdLife International 2020); and
- An estimated 36-70% of the world's population of Brown Skua (*Catharacta Antarctica*) (IUCN Red Listed as 'Least Concern' BirdLife International 2018).

Fluctuations in such populations are likely to affect the global conservation status of these species.

Falklands Conservation initiated the Falkland Islands Seabird Monitoring Programme (FISMP) in 1989. 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 monitoring sites and of species. A summary of the current programme is provided in **Table 1**.

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 List 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 the monitoring programme results from the 2021/2022

breeding year as well as contributed data collected by landowners at Dunbar and Bleaker Island settlements. These results are incorporated, along with historic data and island-wide census data to provide information on population trends in monitored species.

Table 1. Summary of the FISMP seabird study species, survey effort and survey coverage of the estimated national breeding populations.

Species	Annual Survey effort	Percentage of national estimate	National Estimate Source
Gentoo penguin	11 sites (17 colonies)	18 % (of 132,000 pairs)	Baylis <i>et al.</i> 2013a
Southern Rockhopper Penguin	5 sites (14 colonies)	2.6 % (of 319,000 pairs) Sites include Steeple Jason which holds approx. 67% FI population	Baylis <i>et al.</i> 2013b
King Penguin (<i>Aptenodytes patagonicus</i>)	1 site (2 colonies)	over 95 %	Pistorius <i>et al.</i> 2012
Magellanic Penguin	1 site	<1 % of 76,000 to 142,000 pairs	Woods and Woods 1997
Black-browed Albatross	1 site (6 study areas)	0.5 % – 0.6 % of 475,500 to 535,000 pairs. Site is most important breeding site globally and 39 % national population	Wolfaardt 2012
Southern Giant Petrel	1 site (3 colonies)	8.6 % of 20,970 pairs	Stanworth and Crofts 2017
Brown Skua	1 site (4 colonies)	3-5 % of 5,000 – 9,000 pairs	Woods and Woods 1997
Imperial Shag (<i>Leucocarbo atriceps</i>)	3 sites (4 colonies)	<1 % 45,000 – 85,000 pairs	Woods and Woods 1997

Methods

Within this report, breeding periods are referred to by the year in which they commenced, for example; 2021 describes the 2021/2022 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**, with a summary of count dates for locations given in **Appendix 1**. GPS locations of colonies are provided in **Appendices 2 to 5**.

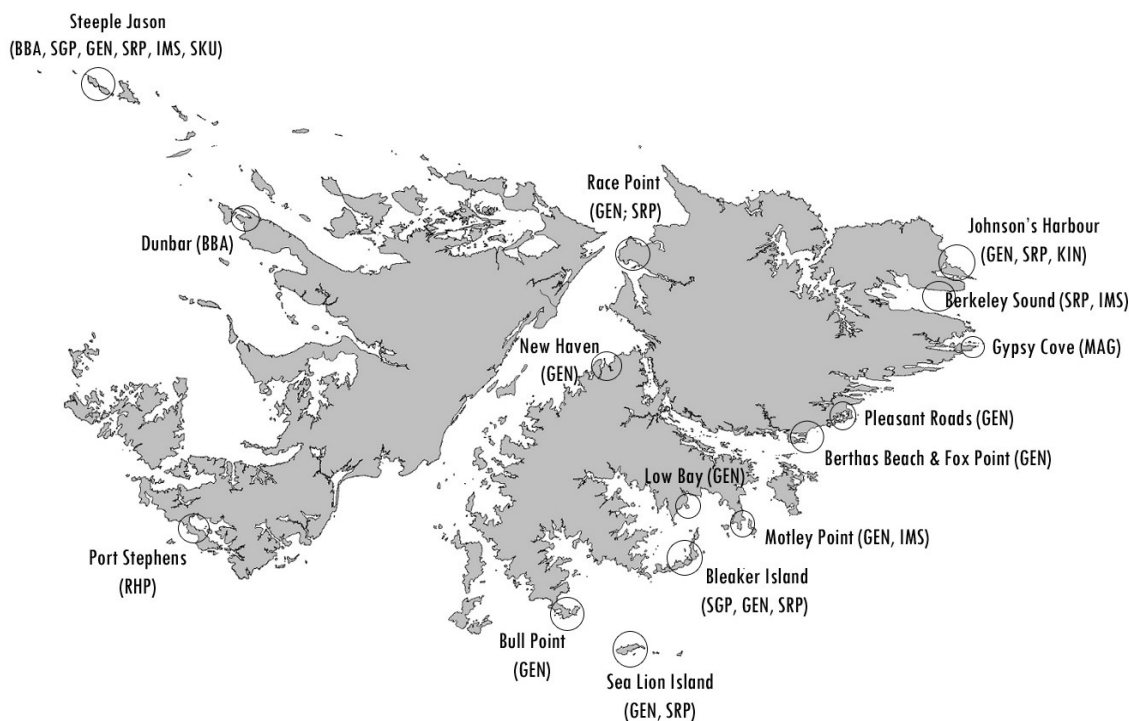


Figure 1: Map of the FISMP monitoring locations.

The work was carried out by Falklands Conservation under Falkland Islands Government (FIG) Research Licences: R21/2017 and R40/2018.

Apparently Occupied Nests (AON) and Pre-fledged Chick (PFC) counts

For AON and PFC counts, photos were obtained using a drone whenever possible. If conditions were too adverse for safe drone flying then GoPro and/or field counts were made. The various methods, or combination of methods, employed for each location/colony are presented in **Appendices 2 to 4** and described below. GPS locations of individual colonies (due south of the approximate centres, 5m from the colony edge) were taken where possible.

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. 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). Drone use is prohibited by the landowner at Volunteer Point and therefore was not used at this site. The inbuilt camera produces 4000×3000 resolution jpeg format images giving a 94° field of view. Images were downloaded and counted using ImageJ software. Counts were repeated a minimum of four times using at least two counters and the average taken. These are referred to in text as 'Drone counts'.

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 using at least two counters and the average taken. These are referred to in text as 'GoPro counts'.

Field counts

Counts were made by eye, where possible at least three times, by two or more observers using tally counters in accordance with standard methods (Thompson & Riddy 1993). These counts were subsequently averaged to give estimates of breeding pair and chick numbers and are referred to in text as 'Tally repeated'.

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 in text as 'Tally agreed'.

Counts at Penguin Point South, Dunbar and Bleaker Island were single counts by a single observer.

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.

Gentoo Penguin

Apparently Occupied Nests (AON) of Gentoo Penguins were counted during egg-laying, over the period 31 Oct. - 20 Nov. 2021 to provide a breeding pair estimate. The number of chicks were counted before fledging (PFC), during the period 1-20 Jan. 2022, 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) – AON only.

Southern Rockhopper Penguin

Southern Rockhopper Penguin breeding pair counts (using AON) were performed from the commencement of egg-laying during the period 31 Oct. - 19 Nov. 2021. Chick counts (PFC) were carried out during 9-18 Jan. 2022. 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 – AON only);
- 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) – counted every 2 years, not counted in 2021.

King Penguin

The population at Volunteer Green 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. No counts were conducted at Volunteer Point in the 2021/22 season.

Imperial Shag

Counts of Imperial Shag (AON – excluding any nests with chicks) were conducted at Motley Point (11 Nov. and 12 Jan. 2021), Berkeley Sound (Eagle Hill and Rugged Hill on 19 Nov. and 18 Jan. 2021) and Steeple Jason (6 Nov. 2021).

Black-browed Albatross and Southern Giant Petrel

Counts of Black-browed Albatross and Southern Giant Petrel breeding pairs (AON) at Steeple Jason were performed during 31 Oct. - 12 Nov. 2021, and in order to estimate breeding success, chicks (PFC) from these locations were counted during 12-16 Mar. 2022. Five locations were counted for Black-browed Albatross. The NW Ridge monitoring site was not counted due to the significant encroachment of South American fur seals (*Arctocephalus*

australis). The presence of the seals impacted access for counting, but would also through their physical presence likely result in displacement of nesting birds. This location is likely to be removed from the FISMP sites. Comparative images to illustrate the encroachment are provided in **Appendix 5**. Three colony locations of Southern Giant Petrel were monitored.

Other Counts

Magellanic Penguin

Transects were carried out every 100 m (approximately) from Engineer Point to the Car Park at Gypsy Cove on 9 Dec. 2021. 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. GPS locations were taken for the start and end of each transect and for the last burrow found. 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.

Brown Skua

Brown Skua counts were initiated on Steeple Jason in 2016. No counts were conducted in the 2021 season. The count unit for Brown Skua at Steeple Jason is Apparently Occupied Territory (AOT) classified as a territory with egg/s and or chick/s observed or an adult sitting tightly on a nest and assumed to be incubating/brooding. Territories are recorded with a GPS position.

Landowner Counts

Counts of Black-browed Albatross chicks were made by the landowner at Penguin Point South, Dunbar on 4 Feb. 2022. Counts were made at Bleaker Island by the landowner for Gentoo Penguin (last week in Oct. 2021), Southern Rockhopper Penguin (27 Nov. 2021) and Southern Giant Petrel chicks (7 Feb. 2022).

Other information

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>). ENSO data is presented as environmental context for the FISMP. 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

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.

Analysis

Before modelling, all those sites that had an average population size of less than 150 breeding pairs were discarded to reduce the influence of smaller population size stochastic fluctuations obscuring the overall trends.

For each site, the count data were mean centred by taking each value, subtracted the mean value and divided by standard deviation, generating a population index. This population index was used as the response variable in Generalized Additive Mixed Models (GAMMs).

To produce the plots of annual index values, we present the yearly population index predicted by the GAMM, with 95% confidence intervals.

The basic GAMM employed was: Standardised Popn. Size ~ Year + site as Random Effect

Results

Gentoo Penguin

Breeding pairs

Of the Gentoo Penguin colonies monitored in 2021 ($n=17$), ten (59 %) showed a decrease in breeding pair numbers when compared with 2020 (**Figure 2**). The overall change in the number of breeding pairs at monitored sites was a decrease of 3.1 %.

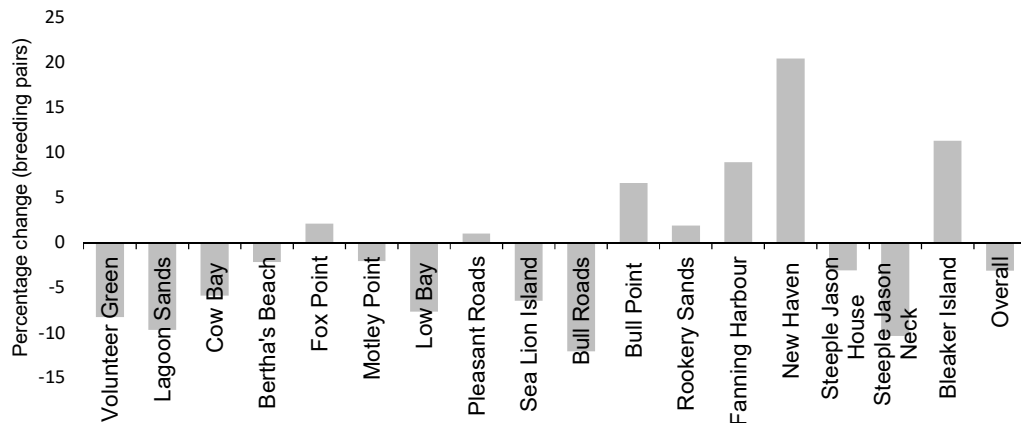


Figure 2: Percentage change of estimated Gentoo Penguin breeding pair numbers between 2020 and 2021 at individual FISMP locations, and overall.

Individual breeding pair estimates over time for monitored sites, by region, are shown in **Figures 3 to 8**. Southeast monitoring sites showed increases in late 1990s to 2000 not exhibited by others, except where possibly inferred from a few data points at Steeple Jason.

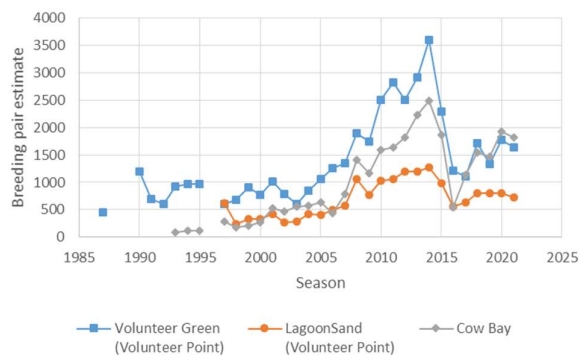


Figure 3: Gentoo Penguin breeding pairs for locations at Northeast Falkland.

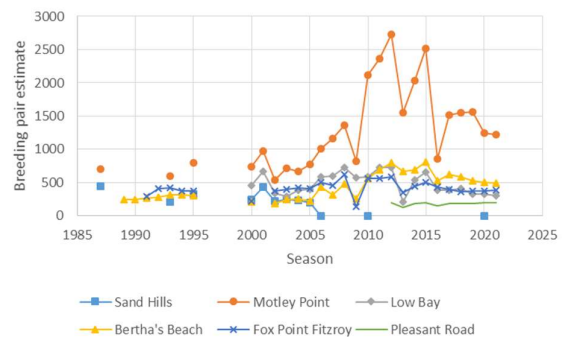


Figure 4: Gentoo Penguin breeding pairs for locations at Mideast Falkland.

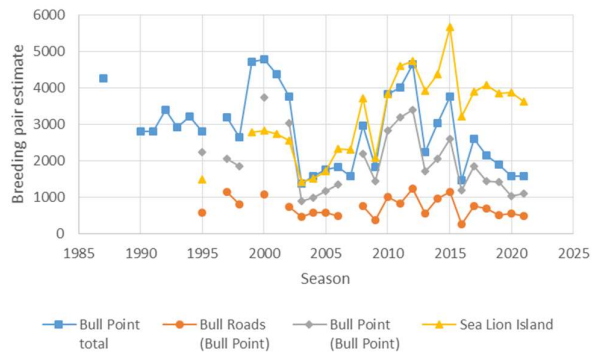


Figure 5: Gentoo Penguin breeding pairs for locations at Southeast Falkland.

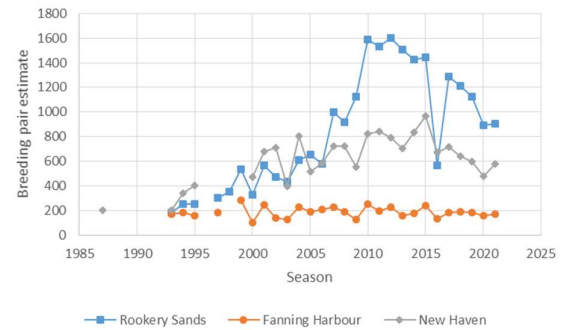


Figure 6: Gentoo Penguin breeding pairs for locations at Falkland Sound.

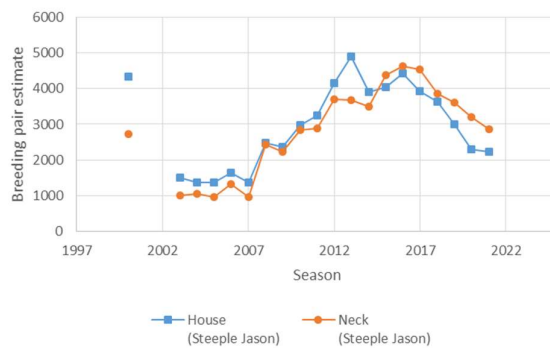


Figure 7: Gentoo Penguin breeding pairs for locations at Steeple Jason.

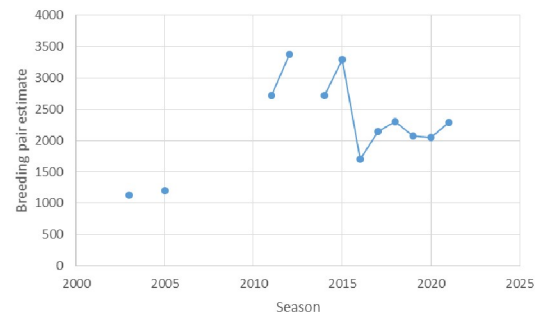


Figure 9: Gentoo Penguin breeding pairs for Bleaker Island.

The breeding population index has been in continuous decline over the last 6-8 years (**Figure 10**). Data from recent seasons indicate a slowing decline, potentially reversing with an increased index value in 2021. The current population index remains above historic monitoring minima and overall support a fluctuating but generally positive breeding population trend in Gentoo Penguin over the monitoring period.

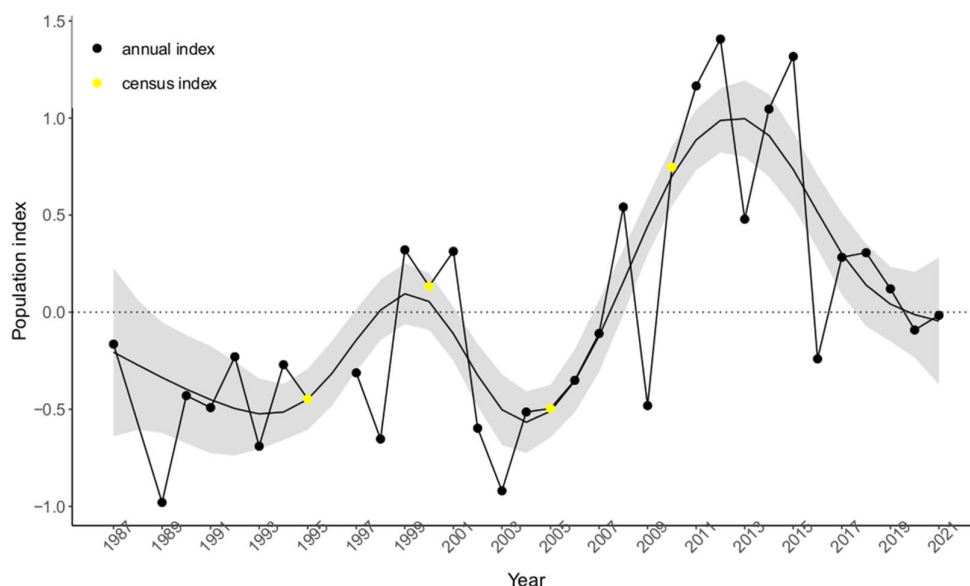


Figure 10: Gentoo Penguin breeding population index 1987 to 2021. Solid line – yearly population index predicted by the GAMM, shaded area - 95 % confidence interval.

Breeding success

Of all the Gentoo Penguin sites for which estimates were derived ($n=14$), eight (57 %) showed a decrease in breeding success when compared with 2020. Bull Roads and Low Bay showed the largest relative declines of 51.5 % and 48.5 % respectively; Fanning Harbour and Rookery Sands the largest relative increases of 34.6 % and 30.0 % respectively (**Figure 11**). Mean breeding success across monitored sites was down 6.2 % since 2020.

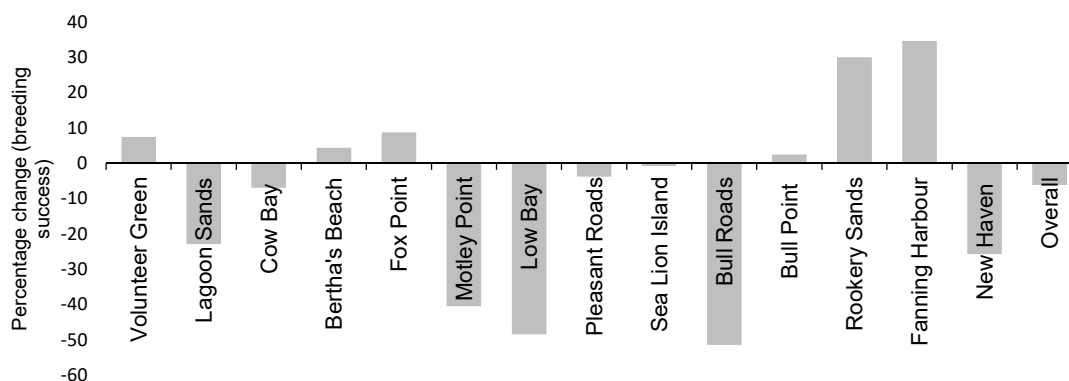


Figure 11: Percentage change of estimated Gentoo Penguin breeding success between 2021 and 2022 at individual FISMP locations. Overall change is calculated between annual averages.

Breeding success varied between locations from a minimum of 0.65 chicks/pair at Bull Roads and 0.75 chicks/pair at Low Bay, to a maximum of 1.44 chicks/pair at Fanning Harbour (Figures 12 to 16).

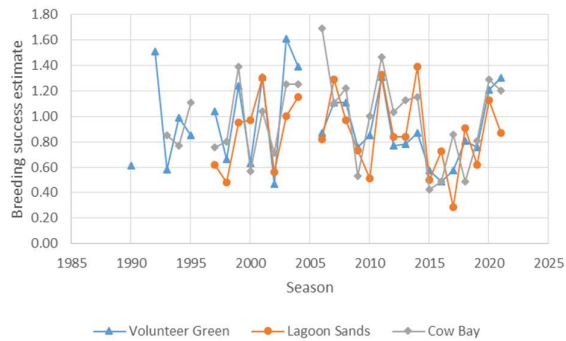


Figure 12: Gentoo Penguin breeding success for locations at Northeast Falkland.

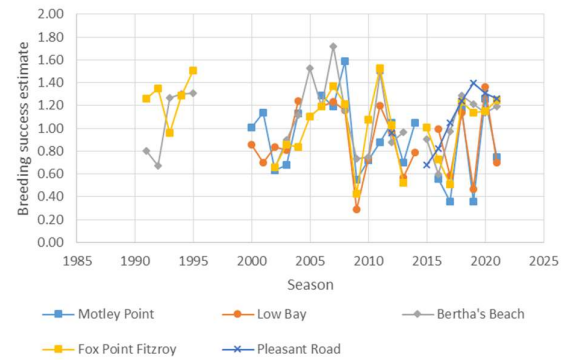


Figure 13: Gentoo Penguin breeding success for locations at Mideast Falkland.

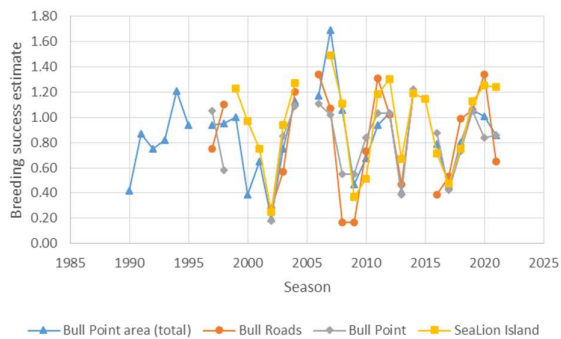


Figure 14: Gentoo Penguin breeding success for locations at Southeast Falkland.

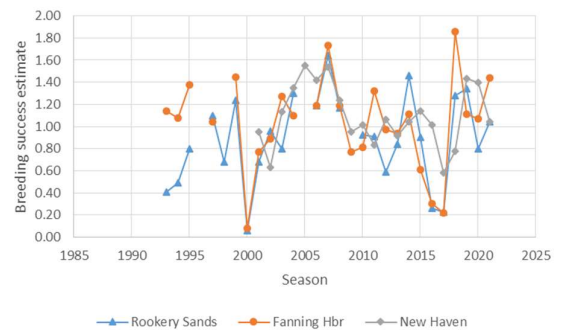


Figure 15: Gentoo Penguin breeding success for locations at Falkland Sound.

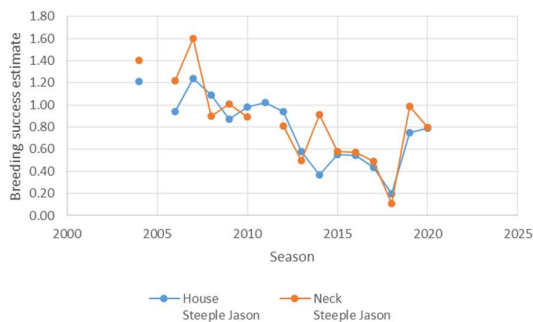


Figure 16: Gentoo Penguin breeding success for locations at Steeple Jason.

Although a seasonal downturn was evident between 2020 and 2021, currently there is not enough data to support an overall downturn in breeding success from its current positive general trend (**Figure 17**).

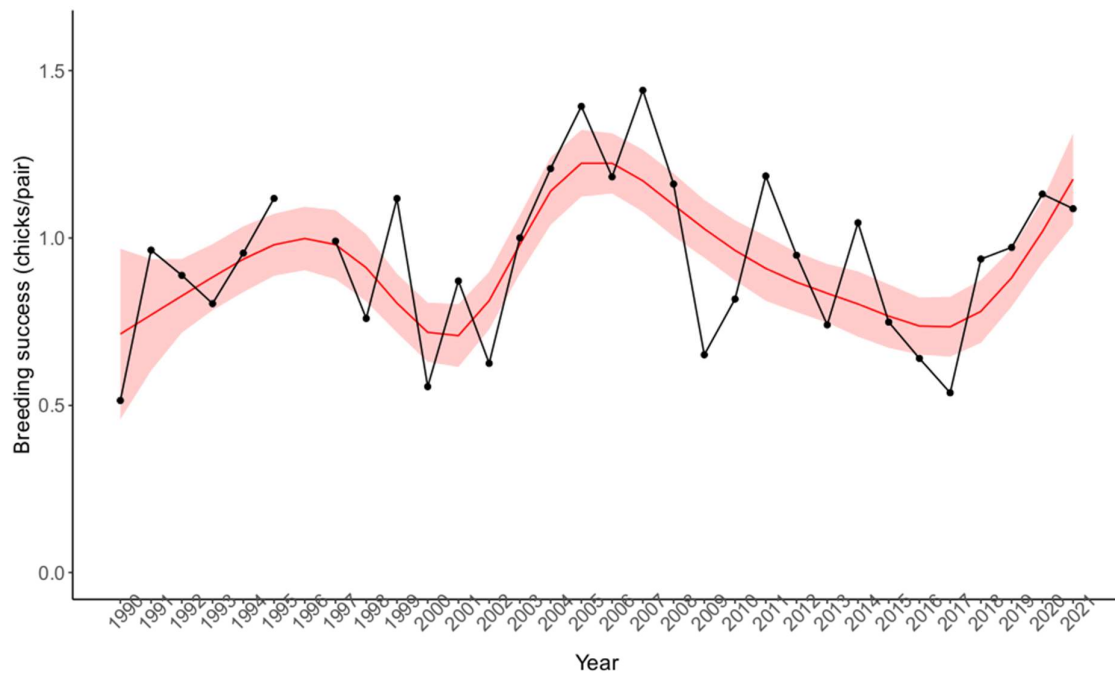


Figure 17: Gentoo Penguin estimated breeding success at FISMP and IWC locations, 1990-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Southern Rockhopper Penguin

Breeding pairs

Of the six monitored locations, four showed decreased breeding pair numbers when compared to 2020 (**Figure 18**). The overall change in the number of estimated breeding pairs at monitored sites was a decrease of 0.83 %.

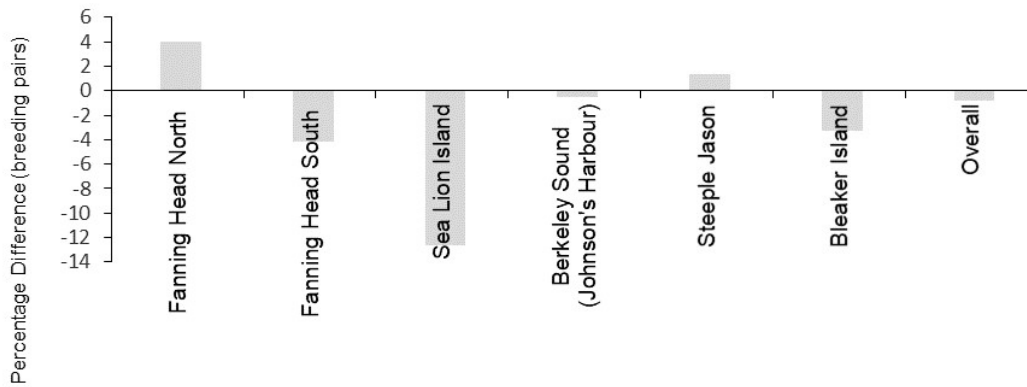


Figure 18: Percentage change of Southern Rockhopper Penguin estimated breeding pair numbers between 2020 and 2021 at individual FISMP survey sites.

Breeding pair estimates over time for monitored sites, by region, are shown in **Figures 19-22**.

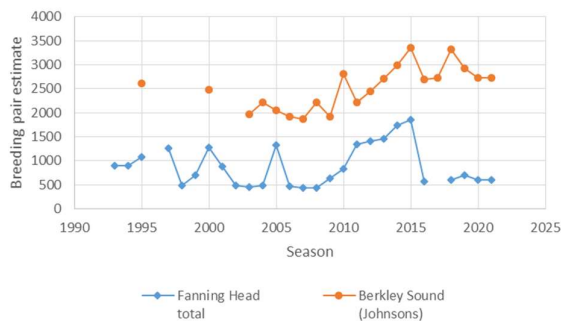


Figure 19: Southern Rockhopper Penguin breeding pairs for locations at mainland East Falkland.

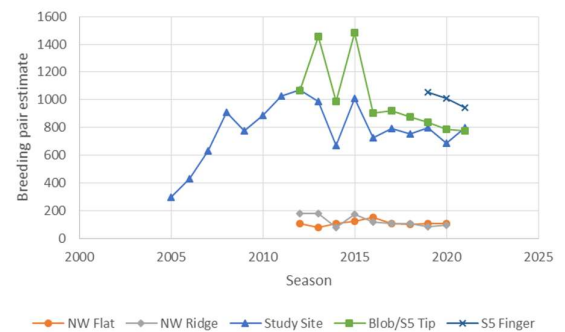


Figure 20: Southern Rockhopper Penguin breeding pairs for locations at Steeple Jason

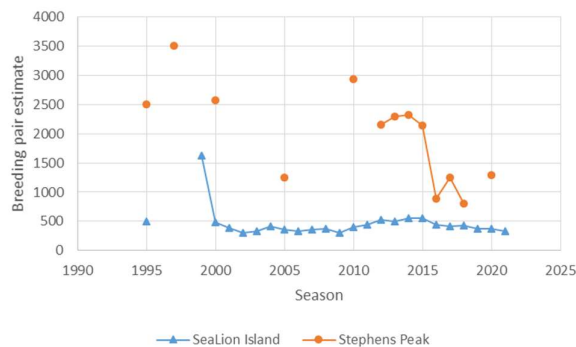


Figure 21: Southern Rockhopper Penguin breeding pairs for locations at South Falklands.

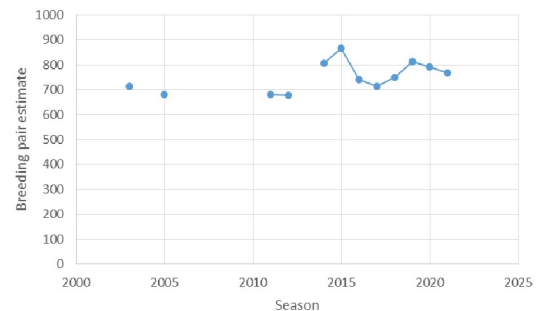


Figure 22: Southern Rockhopper Penguin breeding pairs for Bleaker Island.

The fitted trend for the population index shows a continuing decline over the last 6-8 years (**Figure 23**). Data from recent seasons may indicate a stabilising current trend for the breeding population, however, the long-term population index data support a fluctuating stable/ possibly increasing population.

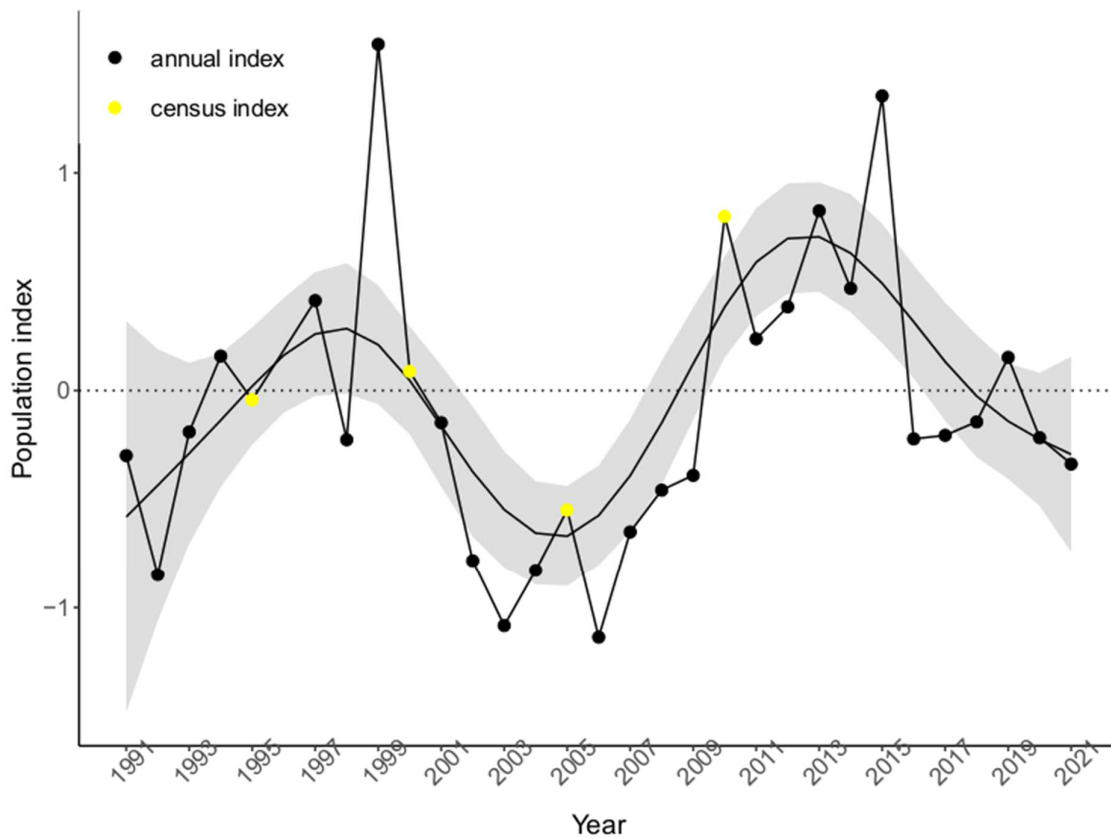


Figure 23: Southern Rockhopper Penguin breeding population index 1987 to 2021. Solid line – yearly population index predicted by the GAMM, shaded area - 95 % confidence interval.

The Southern Rockhopper Population on Steeple Jason was an estimated 38% of the national breeding population in 2010 with 121,369 pairs. Using data for Steeple Jason alone indicates a more notable decline since a downturn around 2011, than indicated when using all FISMP data, with a current index value closer to the low exhibited in 2005 (**Figure 24**).

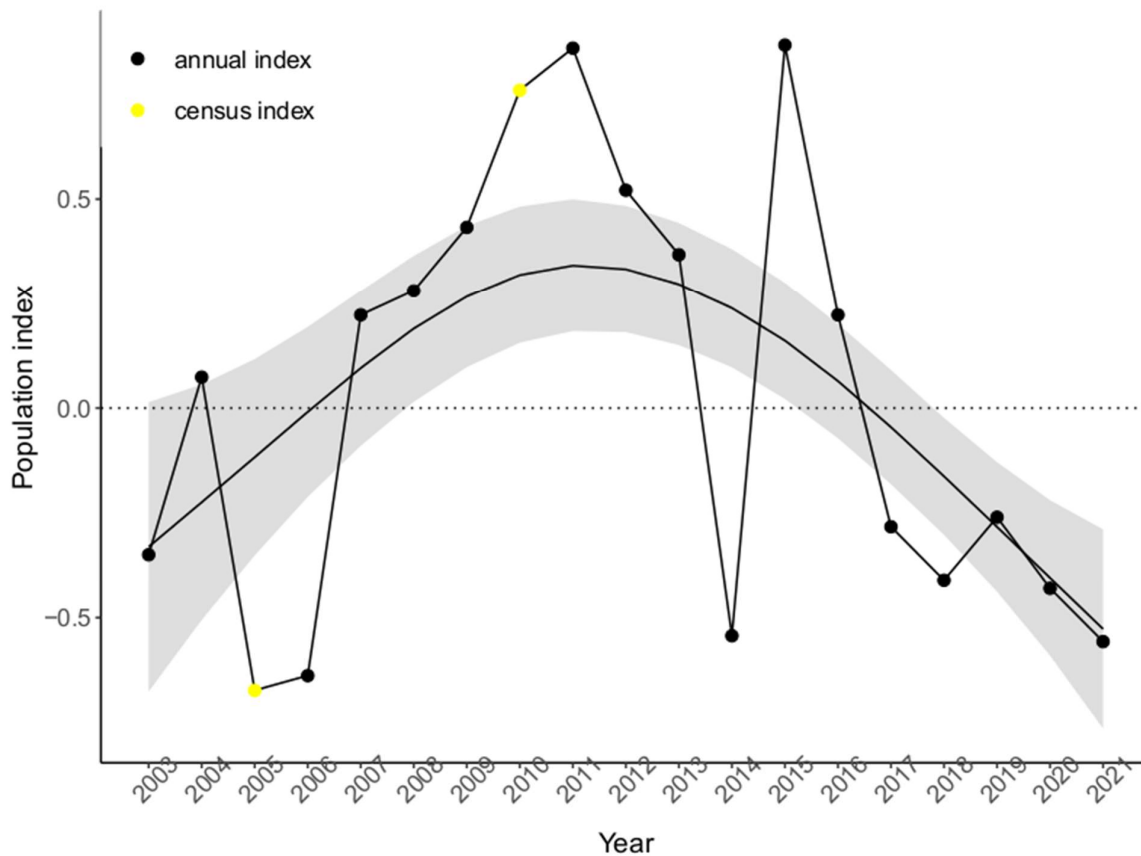


Figure 24: Southern Rockhopper Penguin breeding population index from Steeple Jason data alone data 2003-2021, Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Breeding success

Of the Southern Rockhopper Penguin locations for which estimates were derived ($n=6$), four showed a decrease in breeding success when compared with 2020 and a 15 % decrease overall (**Figure 25**). No breeding success values were obtained for Steeple Jason or Stephen's Peak in 2021. Mean breeding success across monitored sites was down 15 %.

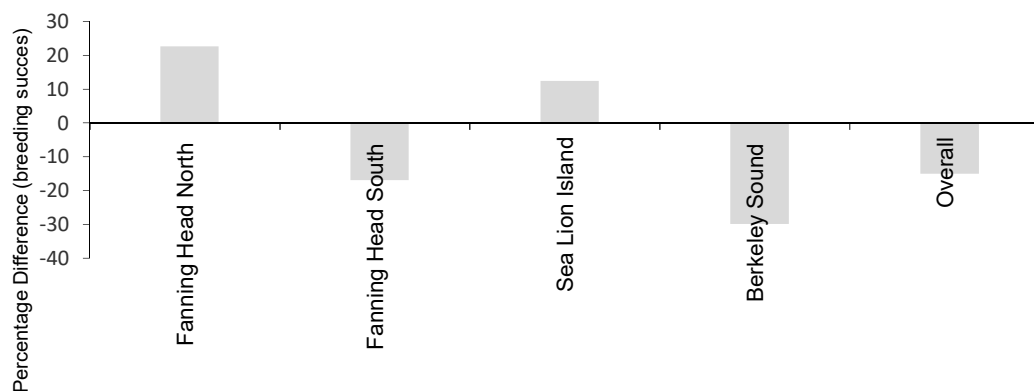


Figure 25: Percentage change of Southern Rockhopper Penguin estimated breeding success between 2021 and 2022 at individual FISMP locations. Overall change is calculated between annual averages.

Estimated breeding success varied between locations from a minimum of 0.36 chicks/pair at Sea Lion Island, to a maximum of 0.64 chicks/pair at Fanning Head. (**Figures 26 to 28**).

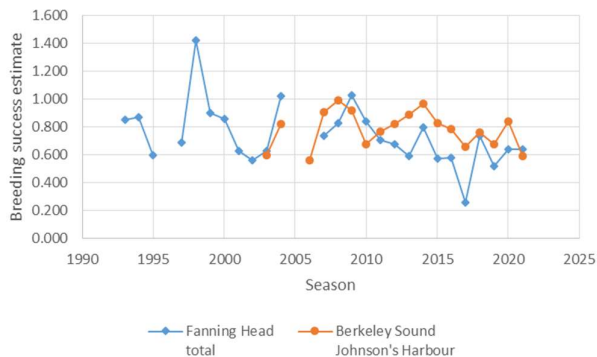


Figure 26: Southern Rockhopper Penguin breeding success for locations in mainland East Falkland.

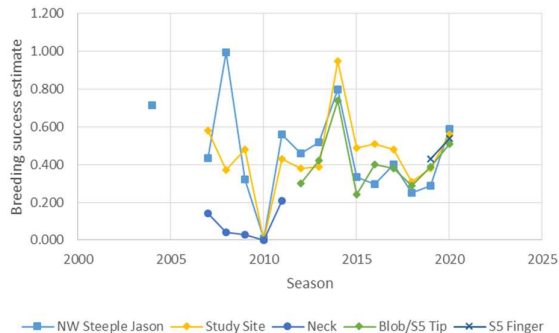


Figure 27: Southern Rockhopper Penguin breeding success for locations on Steeple Jason.

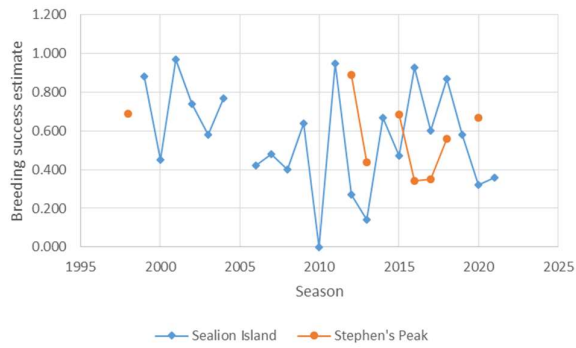


Figure 28: Southern Rockhopper Penguin breeding success for locations in south Falklands.

The fitted trend line for Southern Rockhopper estimated breeding success shows a long-term continuous decline in breeding success over the last 28 years, since monitoring began (**Figure 29**).

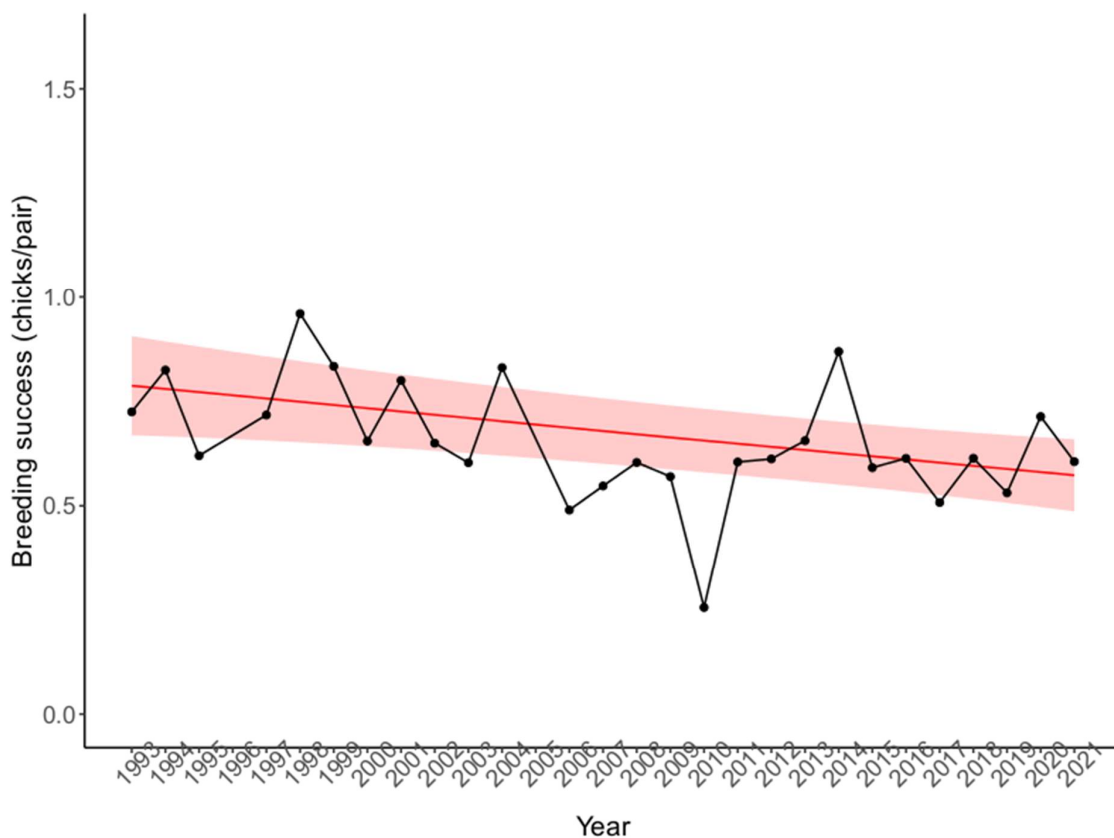


Figure 29: Southern Rockhopper Penguin breeding success 1993-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

King Penguin

No count of King Penguin chicks was undertaken in 2021 as part of the FISMP. A count late in the season by the Volunteer Point warden D. Petterson provided a value of 944 chicks, indicating a continuation of the current upward trend. The number of pre-fledged chicks at Volunteer Point until November 2020 are shown in **Figure 30**.

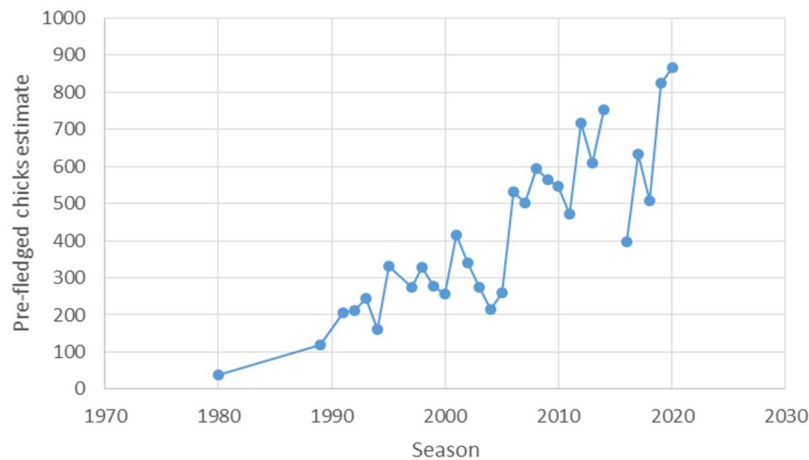


Figure 30: King Penguin pre-fledged chick numbers at Volunteer Point, 1980-2020.

Imperial Shag

Numbers of breeding Imperial Shags at monitored sites in January continue to be highly variable over sites and seasons; however, a decline is generally evident in each of the January breeding pair estimates (**Figure 31**).

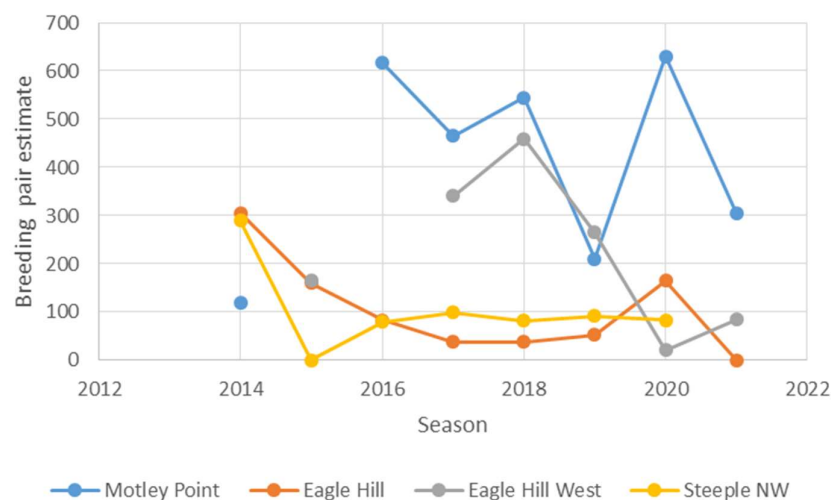


Figure 31: Imperial shag AON (excluding those early breeders already with chicks), from monitored sites in January 2013-2021.

Black-browed Albatross

Breeding pairs

Of those five locations monitored at Steeple Jason, three showed increases in breeding pair estimates and two declines. The highest increase was recorded at the S5 Tip/Blob which was up 12.2 %, whilst the largest decline was at the Study Site, which was down 8.4 % (**Figure 32**). Overall estimated breeding pair numbers at monitored locations on Steeple Jason were up 2.5 % on the previous season.

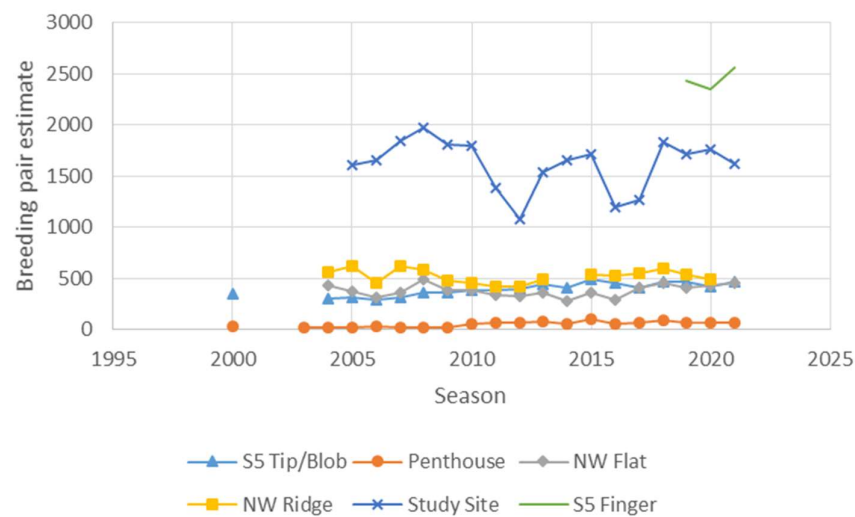


Figure 32: Black-browed Albatross estimated breeding pair estimates at FIMSP locations, Steeple Jason, 2000-2021.

The Black-browed Albatross breeding population on Steeple Jason is the largest globally with an estimated 210,770 pairs in 2017 representing 38.6 % of the Falklands breeding population at that time. The fitted trend line for the breeding population index for Steeple Jason shows a steadily increasing population over the last 21 years (**Figure 33**).

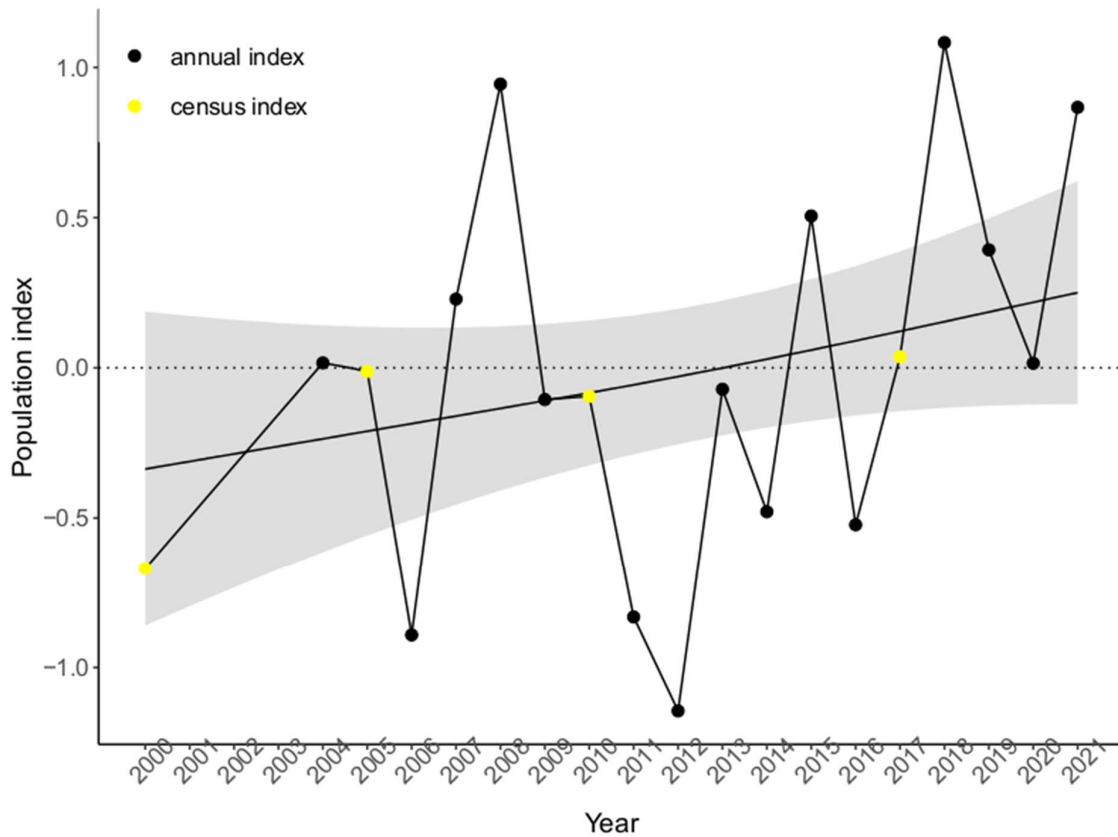


Figure 33: Annual population index and fitted GAMM for Black-browed Albatross breeding pairs at Steeple Jason, 2000-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Breeding success

Breeding success estimates were down at all monitoring locations on Steeple Jason, with the Penthouse site recording zero success for a second season (**Figure 34**). Overall breeding success for the monitored locations was 0.36 chicks/pair, down 29.2 % from 2020. Breeding success was highly varied between the individual colonies; with the Study Site exhibiting an estimated breeding success of 0.51, but with the Penthouse failing entirely.

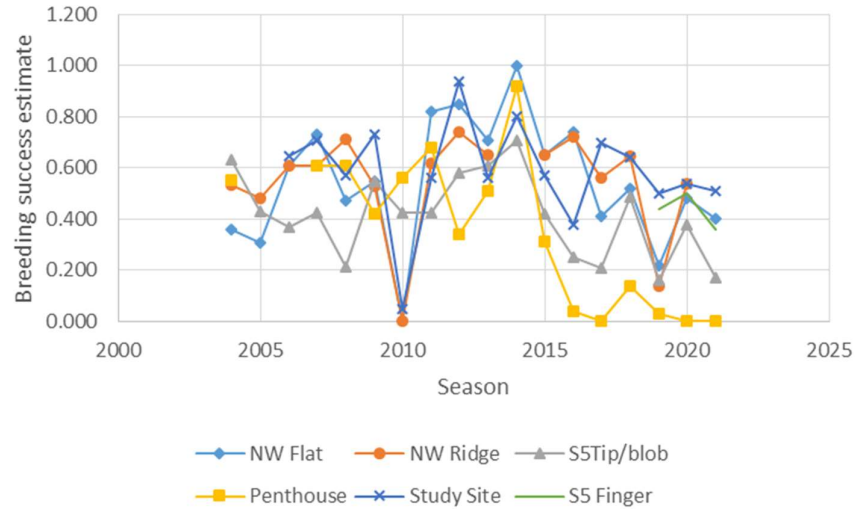


Figure 34: Black-browed Albatross estimated breeding success at FIMSP locations on Steeple Jason, 2004-2021.

The fitted trend line for estimated breeding success indicates a downturn in breeding over the last 7-8 years from a stable/stable-increasing trend in the 10 years prior. The notable downturn appears to begin around the 2014/2015 seasons.

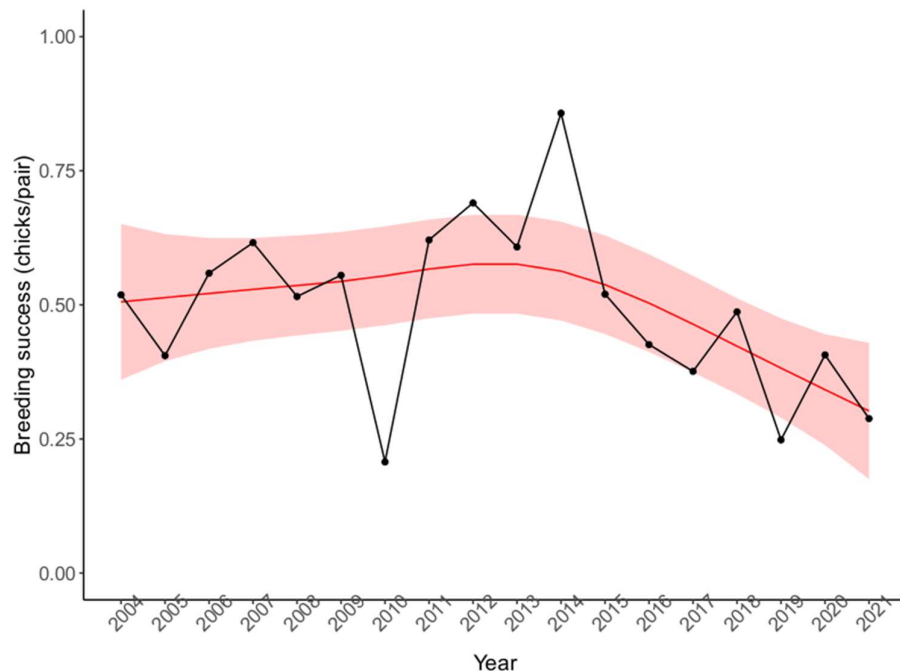


Figure 35: Black-browed Albatross estimated breeding success at FIMSP locations on Steeple Jason, 2004-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Southern Giant Petrel

Breeding pairs

The overall number of estimated breeding pairs of Southern Giant Petrel at monitored colonies on Steeple Jason increased by 2.4 % from an estimated 1,854 pairs in 2020 to 1,899 pairs in 2021. The Neck colony continued a general upward trend and increased by a further 2.0 % on 2020. The NW/S of Ridge/West location continued its decline to almost zero; however, this reduction in breeding pairs has been concurrent with increased use in the House location which had been effectively unused for 7-8 years (**Figure 36**).

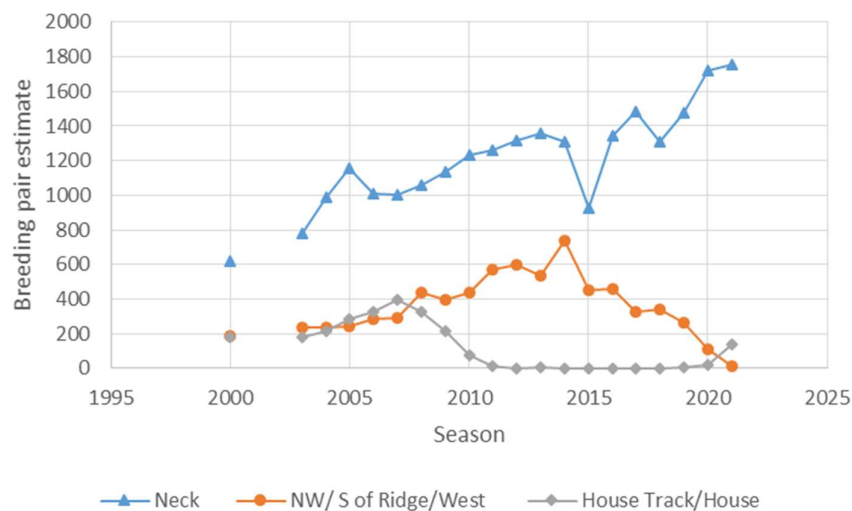


Figure 36: Southern Giant Petrel breeding pair estimates at FISMP sites on Steeple Jason, 2000-2021.

The annual index for breeding pairs indicates continued signs of recovery since the sharp decline in 2014, and a generally increasing trend overall (**Figure 37**).

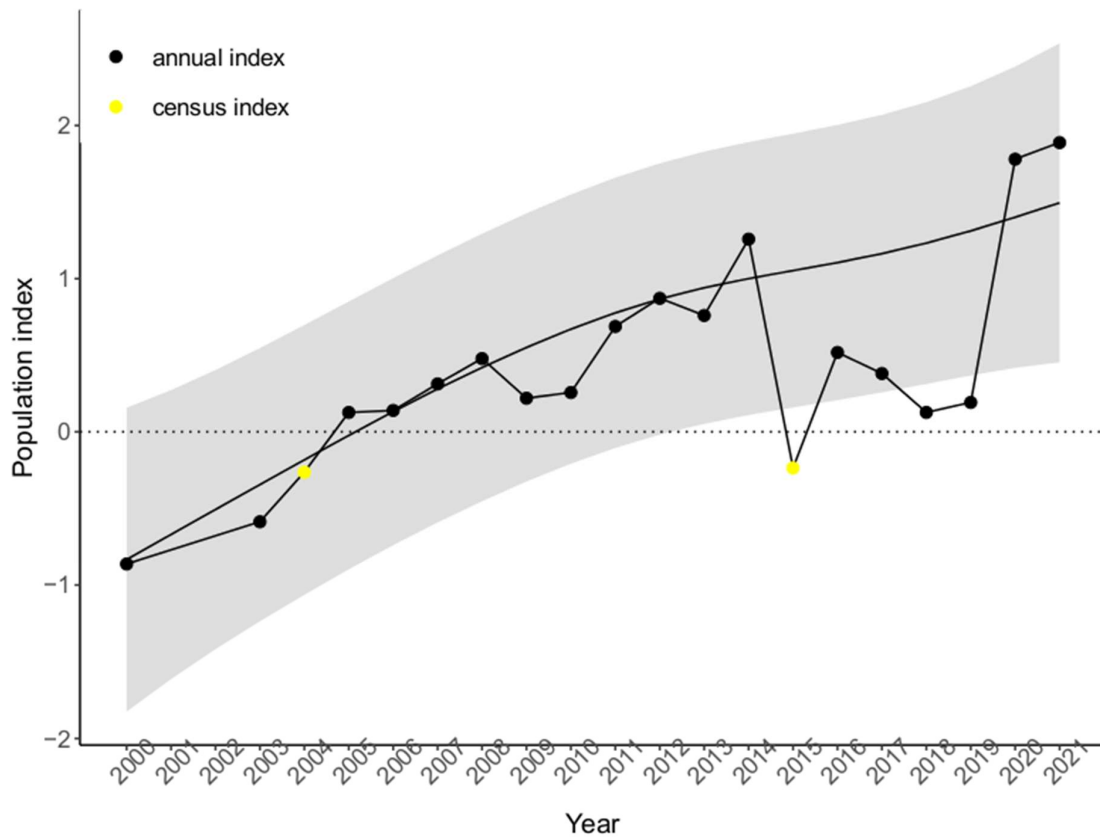


Figure 37: Annual population index for Southern Giant Petrel breeding pairs at Steeple Jason, 2000-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Breeding success

In 2021, average breeding success of the colonies at Steeple Jason was 0.31 ± 0.27 chicks/pair (**Figure 38**). After a long decline the NW/S of Ridge/ West location dwindled to a zero breeding success for the first time. The Neck and House colonies continued increases evident over the last 2-3 seasons.

The fitted trend line for mean breeding success estimates for Steeple Jason indicates a reversal of the long-term decline from 2004 (when monitoring started) until around 2014/15, with an upturn in breeding success indicated over the last 4-5 years (**Figure 39**).

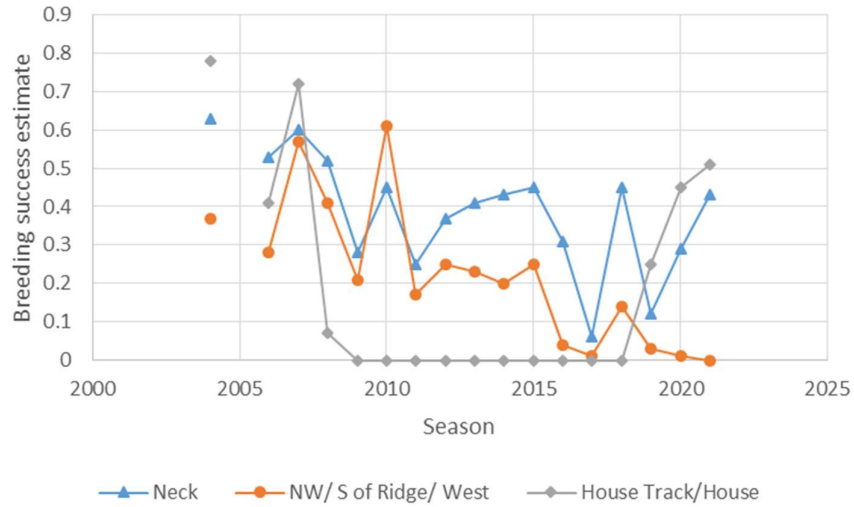


Figure 38: Southern Giant Petrel breeding success estimates at FISMP sites on Steeple Jason, 2004-2021.

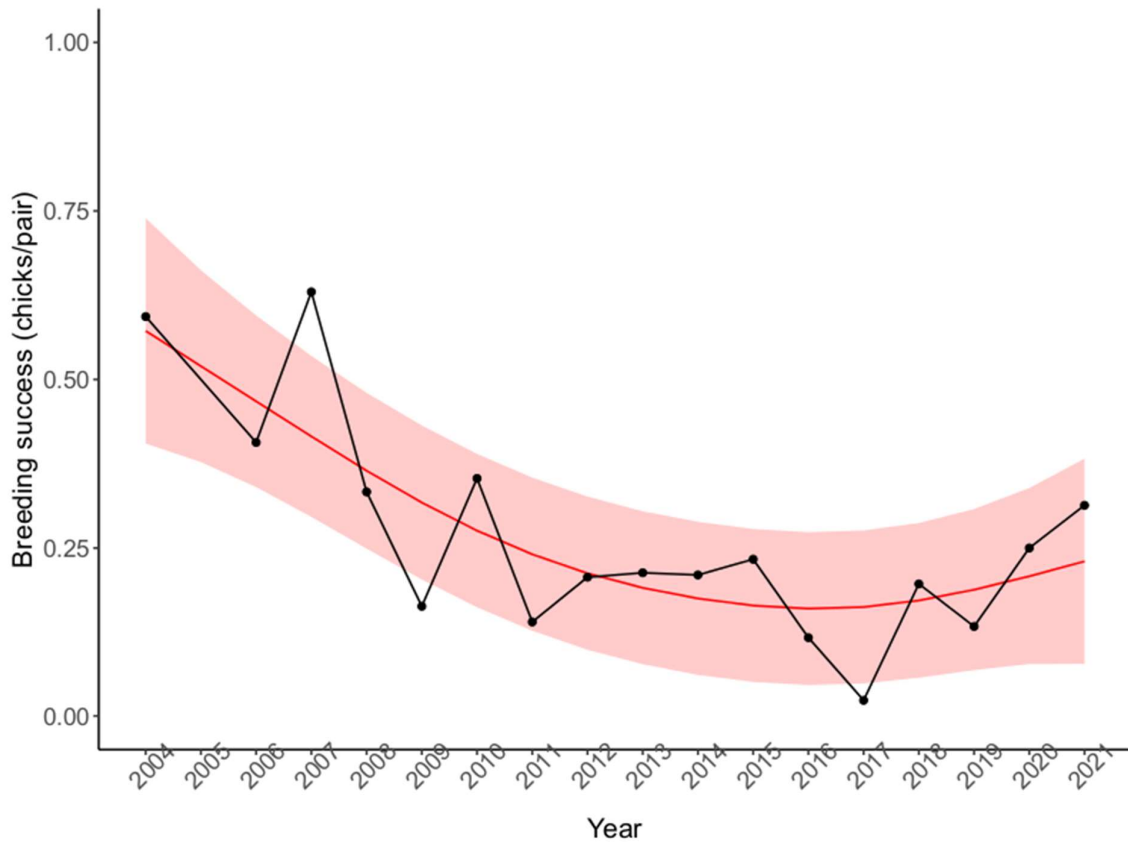


Figure 39: Southern Giant Petrel estimated breeding success at FISMP sites on Steeple Jason, 2004-2021. Solid line – yearly population index predicted by the GAMM, shaded area – 95 % confidence interval.

Bleaker Island pre-fledged chick count

The number of Southern Giant Petrel chicks on Bleaker Island decreased from 142 chicks in 2020 to 131 chicks in 2021 (**Figure 40**).

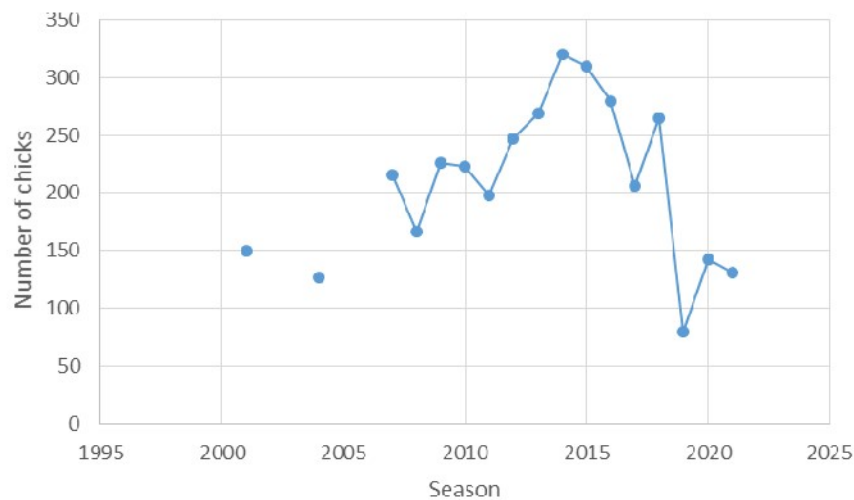


Figure 40: Southern Giant Petrel chick counts at Bleaker Island, 2001-2021.

Magellanic Penguin

The location and extent of transects and the estimated occupied burrow densities at Gypsy Cove are shown in **Figure 41**. Thirty two transects were carried out between Engineer Point and the Car Park at Gypsy Cove, of which less than half ($n = 13$) contained occupied Magellanic Penguin burrows (yellow, orange, dark orange and red coloured bars on **Figure 41**). Burrow distribution was closely associated with tussock grass occurrence.

Where burrows occurred, estimated densities ranged from 3,056 to 29,691 occupied burrows /km², with an average density of 8179 ± 2572 /km² - lower than the previous year of $9,220 \pm 3,704$ /km². Taking all burrows for which there was certainty over occupancy status ($n = 145$), gave an occupancy rate of 18.7 %. This occupancy rate was the lowest since surveying began in 2002 (**Figure 42**).



Figure 41: Transect locations for the Magellanic Penguin survey at Gypsy Cove, 2021. Yellow (≥ 0 and $\leq 10,000$ breeding pairs/km²), light orange ($> 10,000$ and $\leq 20,000$ breeding pairs/km²) and dark orange ($> 20,000$ and $\leq 30,000$ breeding pairs/km²) show minimum breeding pair densities between the shore and the furthest burrow from the shore; grey lines show the extent of each transect where no burrows were present.



Figure 42: Magellanic Penguin estimated burrow occupancy rates from FISMP sites including Gypsy Cove, 2002 -2021.

Brown Skua

No counts were made of Brown Skua in 2021. Survey data to 2020 are included for information. To date, surveys of the Brown Skua breeding population on Steeple Jason indicate an increasing trend (**Figure 43**).

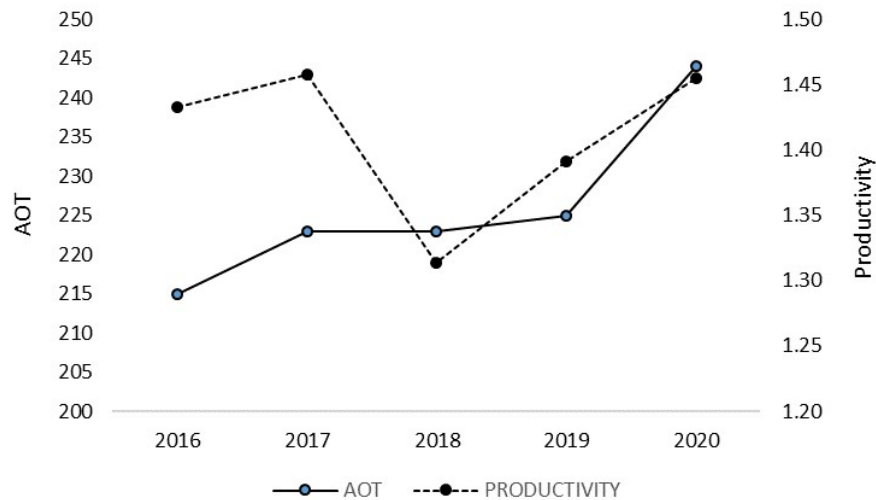


Figure 43: Brown Skua Apparently Occupied Territories (AOT) and productivity at Steeple Jason, 2016-2020.

Environment

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.

Strong La Niña conditions dominated the period of 2020 to 2021 (**Figure 44**).

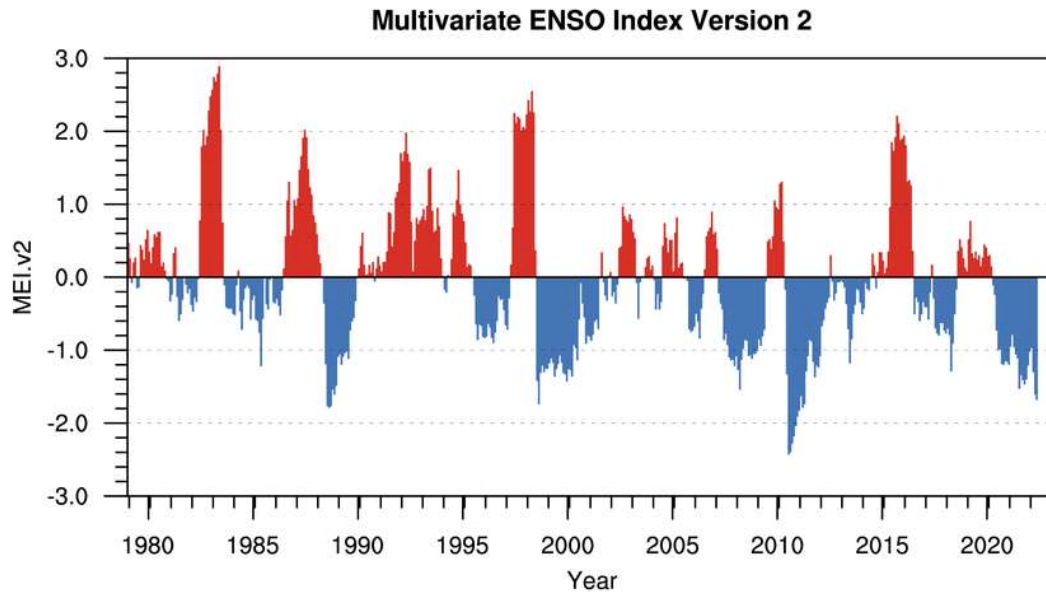


Figure 44: Multivariate ENSO Index

Anthropogenic and other impacts at colonies

Marine plastic

Few pieces of marine debris were noted during the 2021 FISMP fieldwork. Three small pieces of fishing net were observed incorporated into different Gentoo Penguin nests at Bull Point.

Oiling

No oiled birds were observed at the FISMP sites in 2021.

Marine entanglements

No marine entanglements were observed at the FISMP sites in 2021.

Disease

No disease signs were directly observed at monitoring locations during 2021. A landowner on east-coast east Falkland reported approximately 300 dead Gentoo chicks in February.

Post mortem of an individual revealed that the bird was in quite good condition and had a full stomach. The only abnormalities were significant pulmonary changes – lung tissue was dark and congested and there was some white liquid in the lungs. Sample were taken for analysis. No other reports were made.

Discussion

Gentoo Penguin: IUCN status: Least Concern (2020)

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

Breeding population: sites down 3.1 % on 2020; FISMP overall trend: fluctuating, stable-increasing

Breeding success: sites down 6.2 % on 2020; FISMP overall trend: fluctuating, stable/stable-increasing

Globally this species faces a wide range of potential threats, though currently the global population is considered stable (BirdLife International 2020).

Environmental changes driven by regional or global processes such as El Niño and wider climate change are a threat to this species. Changes influencing local oceanography, such as frontal positions can effect food availability (Crawford et al. 2014) and in turn influence breeding pair numbers (Baylis et al. 2011; Handley et al. 2016). Harmful algal blooms (HAB) were attributed as the cause of the paralytic shellfish poisoning incident that resulted in a major Gentoo Penguin mortality event in the Falkland Islands in 2002 (Pistorius et al. 2010). A significant population down turn in 2016 was linked to both disease incidence and food availability aligning with a strong El Niño event in the preceding season (Crofts and Stanworth 2017).

Industry interactions may also pose localised threats to this species including incidental capture in fishing nets (Ellis et al. 1998), oil spills (Lynch 2013) and disturbance from tourism resulting in decreased breeding productivity (Trathan et al. 2008, Lynch et al. 2009, Dunn et al. 2019). Egg harvesting also takes place under licence in the Falkland Islands.

Current FISMP data indicate differing regional responses in breeding colonies from the northwest to the southeast supporting the argument for a strong influence of local conditions on annual breeding populations and breeding success. Overall, however, the long-term index for breeding population size indicates an increasingly fluctuating, but stable or stable-increasing, breeding population in the Islands. The mass mortality event in 2002

and high mortality following a strong El Niño in 2015 coincide with inflexions from increasing to declining trend in the breeding population index, indicating the probable significance of the above threats to the Falklands breeding population. Though in current decline, the population index exhibited notable increase from around 2004 to 2015 before this, and currently the index remains above that evident at the start of monitoring in 1987.

The long-term trend in estimated breeding success is broadly inverse to that of population size, with higher breeding success broadly occurring in periods of lower population estimates. Currently, the breeding success trend remains positive, providing potential for a slowing and reversal of the population decrease as individuals recruit into the breeding population.

The Gentoo Penguin's flexible breeding phenology and reproductive potential (3 chicks), combined with an early onset of breeding maturity around the age of 3 years, provides good potential for population growth under appropriate conditions and this may be significant in providing the recovery potential needed to respond to historic and current threats. Whether this will be sufficient in the future, either to cope with increased magnitude or frequency of threats is uncertain. The incidence of breeding deferral in this species (Crawford et al. 2006), and the lack of demographic data, leaves the relationship between the breeding population size and overall population in the Islands size unknown.

Southern Rockhopper Penguin: IUCN status: Vulnerable (2020)

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

Breeding population: sites down 0.8 % on 2020; FISMP overall trend: fluctuating, stable

Breeding success: sites down 15 % since 2020; FISMP trend: long-term declining

Southern Rockhopper Penguin populations have declined rapidly from huge abundance in the first half of the 20th century, and the global population is suspected to continue to decline at a rapid rate. The IUCN Red List assessment states that 'While some colonies appear to have stabilised, mass-mortality events believed to be connected to water

temperature mediated food availability are occurring too frequently for populations to recover’ (BirdLife International 2020).

Climate change appears the key threat to the species with ocean temperatures affecting adult survival (Raya Rey et al. 2007, Dehnhard et al. 2013a) and specifically in the Falklands causing delayed breeding, lighter eggs and likely reduced breeding success (Dehnhard et al. 2015a, b) as well as food availability collapse (Dehnhard et al. 2013a). Increased storm events, predicted under climate change for the Islands, may affect breeding habitats and survival (Wolfaardt et al. 2012) whilst climate change mediated effects on prevailing wind direction is likely to affect foraging success (Dehnhard et al. 2013b).

The massive mortality event on the Falklands in 2002/03 was attributed to a HAB, causing mortality via paralytic shellfish poisoning (Uhart et al. 2007). Impacts were region-wide, and affected populations took several years to recover (Crofts 2014). At the Falklands and in southern Patagonia, adult mortalities occurred during the moulting period following the breeding season 2015/16 (Crofts and Stanworth 2016, 2017; Morgenthaler et al. 2018; A. Raya Rey Pers. Comm.). Documented impacts of disease remain few, though small scale mortalities are recorded and avian pox is known to be present in the Falklands (Crofts 2014, Crofts and Stanworth 2020).

Other potential localised threats include sealion predation, oil spills and tourism (Crofts 2014)

Southern Rockhopper Penguin show regional similarities in breeding pair trends in the Islands. Like Gentoo Penguin the breeding population of this species appeared to respond adversely to the HAB event in early 2000’s and a strong El Niño in 2015. However, in spite of this, against a backdrop of sharply declining populations globally, the longer-term data set for the Falkland Islands indicates a fluctuating but stable, perhaps even slightly increasing, breeding population of this species. It is important to consider the monitoring approach in evaluating this overall trend. Southern Rockhopper Penguin sites outside of Steeple Jason represent small proportions of the overall population and analysis of the Steeple Jason sites alone indicate perhaps a more pronounced current decline in the sub-sample of the largest

Falkland Islands colony than indicated from the annual index derived from all sites.

The breeding population trend does not particularly align with the strong indications of an apparent long-term downward trend in breeding success. Breeding success in this species appears much less variable to that of Gentoo, with much less marked, if any, oscillations clearly visible with current data. The population recovery capacity of this species does not compare with the Gentoo penguin, with maturity reached from 4 years and onwards of age, with typically only 1 out of a possible 2 chicks raised. The longer-term effect of this lowering productivity, possibly mediated by more consistently occurring, and perhaps less obvious pressures, must be a concern for maintaining a future stable population. However, as with Gentoo, a lack of demographic data, and breeding deferral, hinders a full understanding of the wider overall population to buffer apparent changes in the breeding population in the Islands.

King Penguin: IUCN status: Least Concern (2020)

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

The FISMP 2021 annual change in chick numbers: not counted, anecdotal increase. FISMP overall trend: increasing

Globally this species is thought to be increasing (BirdLife International 2020) with an estimated 1.1 million pairs breeding annually. The relatively small Falklands' population occupies the northern limits of the global range for this species. Climate change, human disturbance, feral cats and predation by Brown Skua and Southern Giant Petrel are all noted as threats which could impact the species and that occur at the survey site.

No count was undertaken at Volunteer Point in 2021 as part of the FISMP; however, a count provided by the site warden later in the season indicates further increases and a continuing positive trend.

The long-term monitoring at Volunteer Point indicates a long, overall steadily increasing population since monitoring began in 1980. This may be due to increased immigration (i.e.

from the large population at South Georgia), improved feeding conditions (Pistorious et al. 2012) or other factors increasing survival or productivity. Certainly threats, particularly natural predators, are present and acting upon the colony to differing degrees in any season; however, the current trend for the site is consistent with the global trend for this species.

Imperial Shag: IUCN status: Least Concern (2020)

Falkland Islands breeding pair estimate: 45,000 – 84,000 pairs (The global population size has not been quantified owing to a recent taxonomic split.)

FISMP 2021: a general decrease in estimated breeding pairs in January at each monitoring site may be emerging

This species has a very large range, the population is not believed to be decreasing sufficiently rapidly (though the trend is unknown) or be of small enough size to be evaluated as anything other than least concern. Threats to the species are regionally variable, but include natural predation, over-fishing and disturbance (BirdLife International 2020)

Information on the Falklands Island population of this species is limited. Monitoring is made difficult by colony locations, but also deriving representative counts for a species that breeds in groups of tens or thousands, either individually or mixed with several other species, and exhibits a dual peaked breeding season with birds laying in spring or summer. The currently monitored sites are likely extremely limited in their ability to indicate national trends. Little is known about the species in the Islands. In 2021 at monitored sites, Imperial Shag numbers continued to fluctuate seasonally; however, a general decrease in estimated breeding pairs in January at each monitoring site may be emerging.

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

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

Breeding population: sites up 2.5 % on 2020; FISMP overall trend: increasing

Breeding success: sites down 29.2 % on 2020; FISMP overall trend: decreasing

Globally the population of this species is considered to be increasing (BirdLife International, 2018). Historically key threats identified for the species have always been dominated by fisheries by-catch mortality (Kuepfer et al. 2022); however, climate change is increasingly known to pose a significant threat to the species broadly (Barbraud et al. 2001) and in the Falklands (Ventura et al. 2021). Demographic data for the world's largest colony of the species also supports persisting population level impacts of extreme storm events (Ventura et al. in prep), which are predicted to increase under climate change (Jones et al. 2016). Disease is also a contributing factor (Ventura et al. 2021)

The overall Falkland Islands population (around 72 % of the global population) has shown an increase in breeding pair numbers between 2005 and 2017 (FC data in prep). The trend index for annually monitored sites at Steeple Jason (the largest breeding colony for the species) similarly indicates an increasing breeding population since monitoring began there in 2000. Although the last island-wide census was conducted relatively recently in 2017, indications from FISMP monitoring sites are of further increases in the breeding population since then.

The overall breeding success in 2021 was the fourth lowest on record from FISMP. Breeding success in Black-browed Albatross at Steeple Jason has exhibited a downward trend since the strong 2015 El Niño event and at this point the breeding success fitted trend is at the lowest point since monitoring on Steeple Jason began, with no clear and repeatable threats in evidence to associate with such a situation.

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

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

Breeding population: sites up 2.4 % on 2020; FISMP overall trend: stable-increasing

Breeding success: sites up 24.0 % on 2020; FISMP overall trend: stable-increasing after long decline

Globally this species is considered to have undergone a slow decline during the last Red List assessment period; however, recent data indicate the global trend is currently increasing (BirdLife International, 2018). Fisheries by-catch and persecution have been notable historic threats to this species in the Islands, though both are presumed much reduced at present.

Estimated breeding pairs on Steeple Jason, monitored since 2000, show a trend indicative of a stable/stable-increasing breeding population over the last 21 years. The trend index for the Steeple Jason population (which is roughly 8 % of the national population (Stanworth and Crofts, 2017)) compares with indexed island-wide census data, indicating a potential national breeding population increases of around 30 % since the last census in 2015.

At Steeple Jason colony fluctuations continue, with further increases at the previously abandoned 'House' colony and declines to almost zero this season at the NW/ South of the Ridge/ West site, which in 2012 had 599 breeding pairs. It remains difficult to account for the re-distribution of pairs at Steeple Jason. 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 the highest in over 10 years and recent figures since 2018 have shown a reversal of the long-term decline in breeding success evident at the site. Up until this point an increasing breeding population and decreasing breeding success suggested potential resource limitation, given the species is a central place forager and other large colonies also exist on adjacent Islands; however, current trends are less supportive of this concept and the actual cause is unknown. Opportunities to assess breeding performance at a broader scale for the Falklands' population would be beneficial, as this may be a site specific issue.

Magellanic Penguin: IUCN status: Least Concern (2020)

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

Burrow occupancy: down 58 % to 18.7 %, which was the lowest on record since 2002.

Overall FISMP sites indicate a stable/ stable declining occupancy rate at the site over the monitoring period.

Globally this species is considered stable or slowly declining, with identified threats including recreation and tourism, and non-native species (Birdlife International 2020), which also occur at the survey site.

At Gypsy Cove in 2021, Magellanic penguin burrow occurrence remained strongly associated with the extent of tussock grass habitat, as in previous years. Exclusion of grazing in colony areas at Gypsy Cove has allowed recovery of tussock habitat, reducing an identified threat and increasing opportunities for colony expansion.

In 2021, the burrow occupancy rate of 18.7 % was the lowest since records started at Gypsy Cove, and fourth lowest for those sites reported. The general trend at Gypsy Cove for this species is reflective of that seen in Gentoo and Southern Rockhopper Penguin which has been of declines in breeding pairs since 2015 following the strong El Niño event. There is currently no measure of breeding success to compare with other species trends.

The IUCN RedList assessment notes population fluctuation in the species and, considering occupancy rate fluctuations at Gypsy Cove, there are not currently data to support clear long-term declines in the resident population. Historic data show higher occupancy rates around 2000 and a decline in occupancy over the following 7-8 years before a recovery period. Further declines in the occupancy rates at Gypsy Cove over the next few years would be beyond the extent of previous recorded fluctuations and may give stronger indications of actual declines at the site should they occur. How much this site reflects trends at other breeding sites for this species in the Falkland's remains unknown.

Brown Skua: IUCN status: Least Concern (2018)

*Falkland Islands breeding pair estimate: 5,000-9,000 (1997) (<10 % of global population)
FISMP site not counted in 2021. Previous data indicates an increasing population trend for the site.*

Globally the population trend is considered decreasing, but does not approach thresholds for higher threatened status (BirdLife International 2018). The largest known colony of the nominate race, *C. antarctica antarctica*, has undergone a 47% decline in the last 5 years.

In the Falklands the New Island population sharply decreased by 47 % between 2004 and 2009 (Catry *et al* 2011); however little information is available on the national population.

At Steeple Jason breeding numbers show an apparent increase in breeding pairs by 12 % between 2016 and 2020. Though the increase is actually more marked, as few or no pairs were evident in key colony areas on Steeple Jason in 2012. No data were collected during the 2021 season.

Anthropogenic and other impacts at colonies

There were few notable impacts in 2021 season with almost no marine debris noted, no oiled birds reported and no marine entanglements. No disease signs were noted at monitoring sites; however, a respiratory conditions was responsible for elevated Gentoo chick deaths at one reported site.

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 Gary and Kirsten, 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. Thanks to Hannah Gatenby, Emma Harte, Ellie Jamieson for helping to count seabirds from drone images and Glenn Welch for working on the data. Big thanks to Fransesco Ventura for his analysis of trends.

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Appendix 1: Count information

Location	Date of breeding pair count	Counters	Date of chick count	Counters
Volunteer Green	20/11/21	S. Crofts H. Gatenby	19/01/2022	G Munro, S Pompert-Robertson, H Gatenby, T Pipkin
Race Point	16/11/21	S. Crofts H. Gatenby	20/01/2022	G Munro, H Gatenby, T Pipkin
Sea Lion Island	07/11/21	M. Morrison	09/01/22	M. Morrison
New Haven	11/11/2021	A. Stanworth M. McLeod	13/01/22	R. Burnett, O. Dempster, G. and M. Welch, E. Bertram
Bull Roads & Bull Point	09/11/21	A. Stanworth M. McLeod	11/01/22	R. Burnett, O. Dempster, G. and M. Welch, E. Bertram
Cow Bay	20/11/21	S. Crofts H. Gatenby	19/01/2022	G Munro, S Pompert-Robertson, H Gatenby, T Pipkin
Low Bay	10/11/21	A. Stanworth M. McLeod	12/01/22	R. Burnett, O. Dempster, G. and M. Welch, E. Bertram
Motley Point	11/11/21	A. Stanworth M. McLeod	12/01/22	R. Burnett, O. Dempster, G. and M. Welch, E. Bertram
Bertha's Beach	05/11/21	M. Morrison	01/01/22	M. Morrison
Fox Point	05/11/21	M. Morrison	01/01/22	M. Morrison
Pleasant Roads	03/11/21	M. Morrison	03/01/22	M. Morrison
Steeple Jason	31/10/21 – 12/11/21	S. Crofts M. Tierney H. Gatenby	12/03/22 – 16/03/22	A. Stanworth, M. Tierney, S. Pompert-Robertson, C. Locke
Lagoon Sands	20/11/21	S. Crofts H. Gatenby	19/01/2022	G Munro, S Pompert-Robertson, H Gatenby, T Pipkin
Diamond Cove	19/11/21	S. Crofts H. Gatenby	18/01/2022	G Munro, S Pompert-Robertson, H Gatenby, T Pipkin
Rugged Hill/Eagle Hill	19/11/21	S. Crofts H. Gatenby	18/01/2022	G Munro, S Pompert-Robertson, H Gatenby, T Pipkin
Port Stephens	Not done		Not done	
Penguin Point South			04/02/22	M-P Delignieres
Bleaker Island	Gentoo – last week in Oct Rockhopper – 27/11/21	N. Rendell	07/02/2022	N. Rendell
Gypsy Cove	09/12/21	A. Stanworth, T. Mawer, P. Jelbes, D. Patience, A. Humphrey, S. Grange		

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	495 ± 5	TR	1.19 ± 0.01	TR
Bull Point	Bull Roads	-52.309364 -59.398188	487 ± 13	TR	0.65 ± 0.09	TR
Bull Point	Bull Point	-52.342591 -59.321461	1096 ± 13	TR	0.86 ± 0.01	TR
Fox Point	Fox Point	-58.45 -51.92	389 ± 4	TR	1.25 ± 0.02	TR
Low Bay	Low Bay	-52.077608 -58.879630	299 ± 21	TR	0.70 ± 0.08	TR
Motley Point	Motley Point	-52.108576 -58.643177	1224 ± 10	D	0.75 ± 0.03	TR
New Haven	New Haven	-51.742073 -59.222044	578 ± 16	TR	1.04 ± 0.06	TR
Pleasant Roads	Pleasant Roads	-51.83 -58.24	203 ± 2	TR	1.26 ± 0.02	TR
Race Point	Fanning Harbour	-51.464667 -59.087958	171 ± 8	TR	1.44 ± 0.06	GP
Race Point	Rookery Sands	-51.434122 -59.106928	906 ± 5	D/TR	1.04 ± 0.03	GP/TR
Sea Lion Island	Sea Lion Island	-52.426578 -59.072513	3622 ± 29	TR	1.24 ± 0.01	TR
Steeple Jason	House	-51.02018 -61.233113	2218 ± 7	D	-	-
Steeple Jason	Neck	-51.034787 -61.214888	2869 ± 5	D	-	-
Johnsons Harbour	Cow Bay	-51.428572 -57.879051	1813 ± 31	GP	1.20 ± 0.03	GP/TR/ TA
Johnsons Harbour	Lagoon Sands	-51.513702 -57.77581	719 ± 4.9	GP	0.87 ± 0.02	GP
Johnsons Harbour	Volunteer Green	-51.478494 -57.837858	1634 ± 18	TR	1.30 ± 0.03	GP/TR

* 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 \pm 1 SD)	Count Type*	Breeding Success (Mean \pm 1 SD)	Count Type*
Berkeley Sound	Diamond Cove	-51.538059 -57.923512	141 \pm 0	TA	0.51 \pm 0.03	TR
	Eagle Hill East	-51.544064 -57.785118	112 \pm 3	TA	0.91 \pm 0.02	TA/TR
	Eagle Hill	-51.544497 -57.802981	734 \pm 18	TR	0.71 \pm 0.03	TR/GP
	Eagle Hill West	-51.545082 -57.810499	815 \pm 54	D	0.63 \pm 0.07	GP
	Rugged Hill East	-51.543674 -57.845031	421 \pm 11	D	0.58 \pm 0.04	TR/GP
	Rugged Hill	-51.5432 -57.85185	498 \pm 57	D	0.55 \pm 0.15	TR
	Rugged Hill West	-51.543488 -57.851570	353 \pm 9	D	0.49 \pm 0.04	GP
Port Stephens	Stephen's Peak	-52.133803 -60.859281	-	-	-	-
Race Point	Fanning Head North	-51.460831 -59.141540	261 \pm 4	TR	0.76 \pm 0.02	GP
	Fanning Head South	-51.469284 -59.137749	340 \pm 8.5	TR	0.54 \pm 0.09	TR
Sea Lion Island	Rockhopper Point	-52.446667 -59.115501	327 \pm 9	TR	0.36 \pm 0.03	TR
Steeple Jason	Northwest Flat	-51.012810 -61.252682	109 \pm 4	D	-	-
	Northwest Ridge	-51.012939 -61.252884	-	-	-	-
	S5Tip	-51.037932 -61.220460	774 \pm 3	D	-	-
	South East	-51.046215 -61.206635	796 \pm 2	TA	-	-
	S5Finger	-51.031884 -61.231434	944 \pm 110	D	-	-

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

Appendix 4: 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	1619 \pm 5	TR/TA	0.51 \pm 0	TA
S5Tip	-51.037 -61.220	568 \pm 11	D	0.17 \pm 0.04	D
Penthouse	-51.031 -61.228	67 \pm 0	TA	0 \pm 0	TA
Northwest Flat	-51.012 -61.252	454 \pm 29	D	0.40 \pm 0.07	D
Northwest Ridge	-51.012 -61.252	-	-	-	-
S5Finger	-51.031 -61.231	2565 \pm 12.2	D	0.36 \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	1753 \pm 90.3	D	0.43 \pm 0.05	PH
Northwest (South of Ridge)	-51.024 -61.248	10 \pm 0	TA	0 \pm 0	TA
House (Northwest track)	-51.017 -61.241	136 \pm 4.4	D	0.51 \pm 0.04	D
Northwest Flat	-51.012 -61.251	-	-	-	-

* TR – Tally Repeated, TA – Tally Agreed, GP – Go Pro image count, D – Drone image count, PH - Photo

Appendix 5: Comparison photos for South American fur seal encroachment into Steeple Jason NW Ridge site.



Top image taken in 2017, lower image 2021 – red dots are fur seals.

