

# CENSUSES OF PENGUIN, BLUE-EYED SHAG *PHALACROCORAX ATRICEPS* AND SOUTHERN GIANT PETREL *MACRONECTES GIGANTEUS* POPULATIONS ON THE ANTARCTIC PENINSULA, 2001–2007

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## SUMMARY

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Here, we report census results for Adélie Penguin *Pygoscelis adeliae*, Gentoo Penguin *P. papua*, Chinstrap Penguin *P. antarctica*, Blue-eyed Shag *Phalacrocorax atriceps*, and Southern Giant Petrel *Macronectes giganteus* collected as part of the Antarctic Site Inventory project during 2001–2007. We report on new breeding populations of Gentoo Penguins in the Yalour Islands, Galindez Island and Cape Tuxen (Antarctic Peninsula), which reflect the southernmost known breeding colonies of this species. We also document range expansion and population increases for Gentoo Penguins throughout the Antarctic Peninsula. Further, we report on the continuing population decline of Adélie Penguins in the Antarctic Peninsula, and present records of all three pygoscelid penguins breeding at Booth Island, the fifth known site where these species nest contiguously on the Antarctic Peninsula.

Key words: Censuses, Antarctic Peninsula, penguins, Blue-eyed Shag, Southern Giant Petrel

## INTRODUCTION

Fieldwork by the Antarctic Site Inventory (ASI) began in November 1994, examining whether opportunistic visits can be used to

- effectively and economically detect possible visitor-caused changes in the physical features, flora and fauna of sites on the Antarctic Peninsula being visited repeatedly by ship-based tourists;
- collect baseline information necessary to detect possible changes in the physical and biologic variables being monitored; and
- determine how best to minimize or avoid the potentially negative effects of tourism and governmental and non-governmental activities in the Antarctic Peninsula area.

The ASI has collected information on Antarctic Peninsula visitor sites frequently and cost-effectively, relying opportunistically on expedition tour vessels and, occasionally, the United Kingdom ice patrol vessel *HMS Endurance* for logistics support. Well-timed visits by trained researchers have proved an effective means of characterizing sites and collecting relevant biologic data (Naveen 1997, Naveen *et al.* 2001, Naveen 2003).

Data collected by the Inventory are intended to assist the implementation of the 1991 Protocol on Environmental Protection to the Antarctic Treaty, which, among other things, requires *a priori* environmental impact assessments for all human activities, including tourism, and monitoring to assess and verify predicted environmental impacts. The goal is to develop a baseline against which changes in the ecosystem can be assessed and, if possible,

determine whether any detected changes are naturally occurring or are anthropogenic, perhaps caused by tourism or other human activities (Naveen 1996). Potential impacts may be short-term or long-term, immediate or cumulative (Benninghoff & Bonner 1985, Abbott & Benninghoff 1990, Emslie 1997, Hofman & Jatko 2002).

In this paper we report on the last six years' worth of census data collected to update earlier efforts reported in Naveen *et al.* (2000). The ASI is conducted by researchers placed on tour ships, and site censuses are taken during zodiac landings or, occasionally, during zodiac tours. The advantages of this approach include wide spatial coverage of the western Antarctic Peninsula, and a negligible "footprint" on the landscape. The disadvantage is that the timing of censuses is opportunistic, and census counts are not always timed with the peak of egg laying or chick crèching as required by the Commission for the Conservation of Antarctic Marine Living Resources Ecosystem Monitoring Program (SCCAML 2004). Off-peak bias corrections are currently being developed (Lynch *et al.* in prep.), but even uncorrected census counts, as reported in this paper, add tremendous spatial and temporal coverage to existing census records and can be used in population analyses (e.g. Woehler *et al.* 2001, Sander *et al.* 2007).

## STUDY AREA

As reported elsewhere (Naveen *et al.* 2000), the Inventory divides the Antarctic Peninsula into six subareas (Fig. 1), designations that are followed here.

- South Orkneys (SO), including Laurie, Coronation, and Signy Islands

- Elephant Island and nearby islands (EI)
- South Shetland Islands (SH), including Deception, Low, and Smith Islands (see Fig. 2)
- Northeast Antarctic Peninsula (NE), from Cape Dubouzet (63°16'S, 64°00'W) and Joinville Island (63°15'S, 55°45'W) to James Ross Island (64°10'S, 57°45'W) (see Fig. 3)
- Northwest Antarctic Peninsula (NW), from Cape Dubouzet (63°16'S, 64°00'W) to northern end of the Lemaire Channel (65°04'S, 63°57'W) (see Fig. 4)
- Southwest Antarctic Peninsula (SW), from the northern end of the Lemaire Channel to the northern part of Marguerite Bay (68°18'S, 67°11'W) (see Fig. 5)

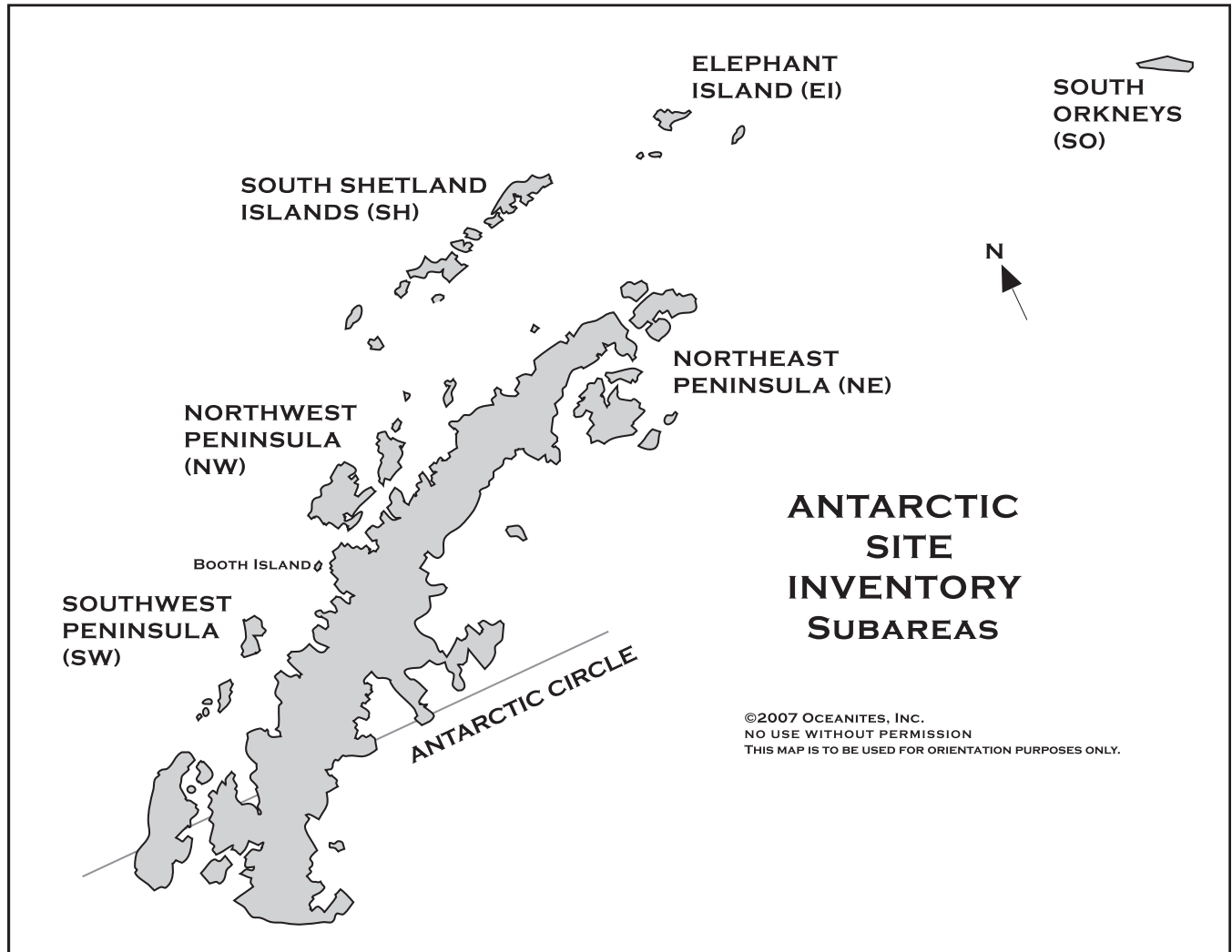
In 13 seasons from November 1994 through February 2007, the Inventory has made 758 visits and collected data at 115 Antarctic Peninsula locations. Inventory researchers have repeatedly visited all those sites that are most heavily visited by expedition tourists, and all sites that exhibit high species diversity or are especially prone to environmental disturbance from human visitors (Naveen 1997, Naveen *et al.* 2001, Naveen 2003).

The present paper provides new census data from each of the six subareas for Adélie Penguin *Pygoscelis adeliae*, Gentoo Penguin *P. papua*, Chinstrap Penguin *P. antarctica*, Blue-eyed Shag *Phalacrocorax atriceps*, and Southern Giant Petrel *Macronectes giganteus*. These long-term data are particularly important now that Antarctic Treaty parties have begun to adopt site specific management guidelines for key visitor locations.

#### CENSUS DATA

The census data reported in Tables 1–5 have been reported in a manner consistent with the census compilations of Woehler (1993) and Woehler and Croxall (1997):

- N1 Nests individually counted, accurate to better than  $\pm 5\%$
- N2 Nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%
- N3 Accurate estimate, accurate to 10%–15%
- N4 Rough estimate, accurate to 25%–50%
- C1 Chicks individually counted, accurate to better than  $\pm 5\%$
- C2 Chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%



**Fig.1.** Map of the Antarctic Peninsula region, indicating the six subareas and their abbreviations, as divided by the Antarctic Site Inventory: the South Orkney islands, Elephant Island and nearby islands, the South Shetland Islands, the Northeast Antarctic Peninsula, the Northwest Antarctic Peninsula, and the Southwest Antarctic Peninsula.

- C3 Accurate estimate, accurate to 10%–15%  
 C4 Rough estimate, accurate to 25%–50%  
 A1 Estimates based on counts of total birds or adults individually counted, accurate to better than  $\pm 5\%$   
 A2 Estimates based on counts of total birds or adults individually counted, accurate to 5%–10%  
 A3 Estimates based on counts of total birds or adults individually counted, accurate to 10%–15%  
 A4 Estimates based on counts of total birds or adults individually counted, accurate to 25%–50%

The site censuses represent all the birds at a particular site, except where indicated by a map. Where multiple nest or chick censuses (or both) are available for a site in any given year, we report the largest December nest count and the largest January chick count available. If no December nest count is available, we give January nest counts priority over November nest counts, and February chick counts priority over December chick counts.

We report on 81 censuses taken at 52 different sites. Among these are 24 census reports that are new to the ASI project. In addition, we note changes from the most recent available census before 2001, and use census that to estimate the annual rate of population change

$\lambda$  between the “baseline” count in year  $t_1$  and the most recent count in year  $t_1 + T$  (Ebert 1999),

$$\lambda = \left( \frac{N_{t_1+T}}{N_{t_1}} \right)^{1/T}, \quad [1]$$

and its error  $\delta\lambda$  (see Taylor 1982),

$$\delta\lambda = \frac{\lambda}{T} \sqrt{\left( \frac{\delta N_{t_1}}{N_{t_1}} \right)^2 + \left( \frac{\delta N_{t_1+T}}{N_{t_1+T}} \right)^2}, \quad [2]$$

where  $\delta N/N$  represents the fractional error of the census (e.g. 0.05 for N1, 0.10 for N2) and  $T$  represents the time difference between the two censuses.

## RESULTS AND DISCUSSION

With respect to Adélie Penguins (Table 1), the Inventory continues to document the population decline of this species in the western Antarctic Peninsula region, most strikingly in the southwestern region subarea (Fig. 6). Inventory data suggest population declines at the Berthelot Islands (65°20'S, 64°09'W), Booth Island (65°05'S, 64°00'W), Petermann Island (65°10'S, 64°10'W), and the Yalour Islands (65°14'S, 64°10'W).

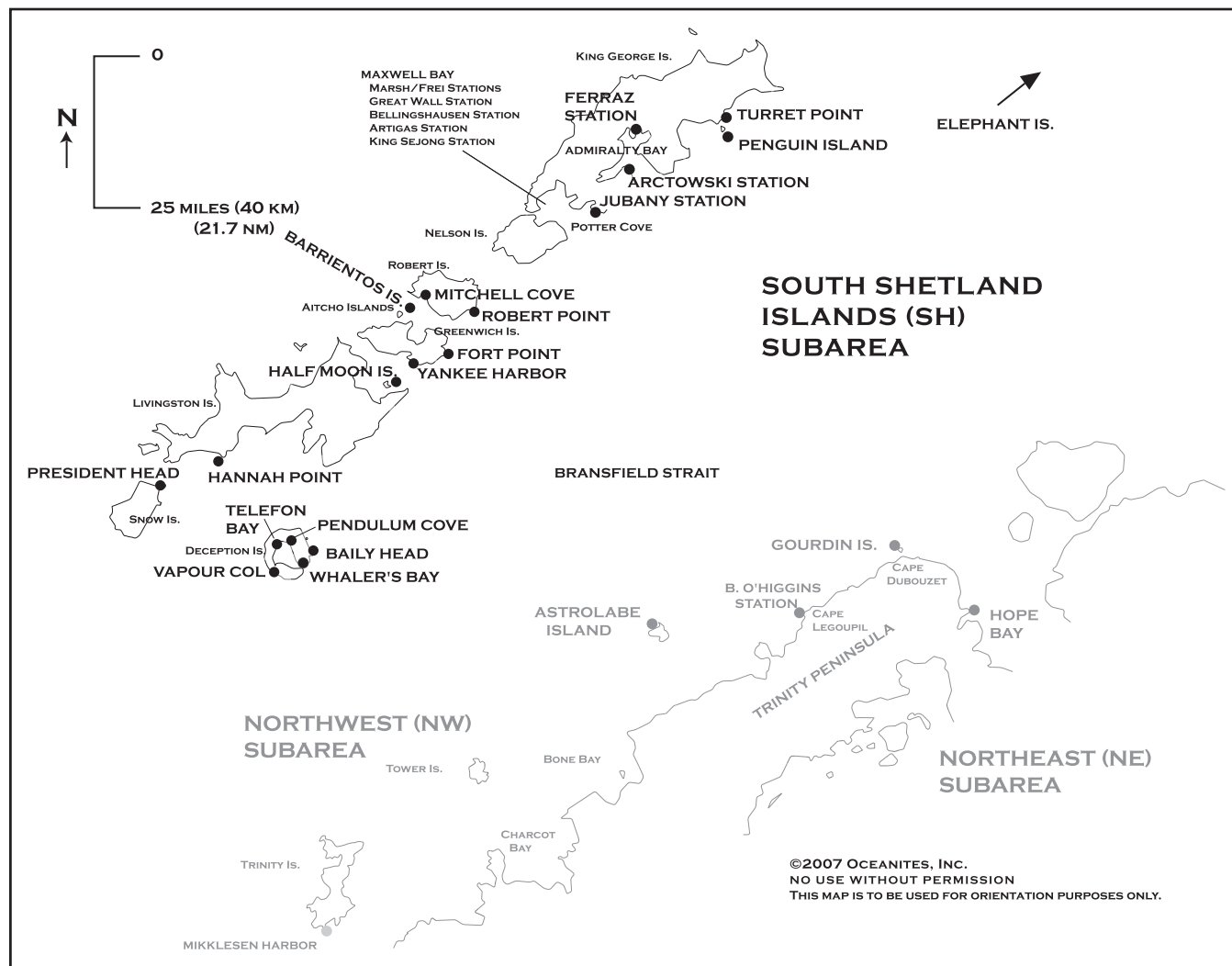


Fig. 2. Map of the South Shetland Islands and parts of the Northwest Antarctic Peninsula region.

With respect to Gentoo Penguins, the Inventory continues to document the population increase of this species in the Antarctic Peninsula (Naveen *et al.* 2000), and for the first time we report the expansion of this species south of their historic range into the Yalour Islands (65°14'S, 64°10'W), Galindez Island (65°15'S, 64°15'W), and Cape Tuxen (65°16'S, 64°08'W). Previously, the southern end of this species' breeding range was believed to be Petermann Island (65°10'S, 64°10'W) (Croxall & Kirkwood 1979). In 2005, one pair of Gentoos made an unsuccessful attempt to breed at Vernadsky Station on Galindez Island (A. Zalizovsky, pers. comm.), and in November 2007, the ASI recorded 21 Gentoo nests at this location. In 2006/07, the Inventory documented 15 Gentoo nests at the Yalour Islands, and in November 2007, there were approximately 100 Gentoo nests at Cape Tuxen (V. Timofeev & V. Trohymets, pers. comm.), which is currently the southernmost known breeding location for Gentoo penguins. This southward expansion of the Gentoo range is consistent with the rapid population growth reported here and elsewhere (Naveen *et al.* 2000), particularly at the southern end of the range (see Fig. 6).

Chinstrap Penguins declined at all sites for which data were available to assess change, with the sole exception of a small increase on Booth Island. Unlike the Adélie Penguins, which are declining principally in the southwestern region subarea, Chinstraps

declined significantly throughout their range. We report declines at Cecilia Island (62°25'S, 59°43'W), Entrance Point (63°00'S, 60°33'W), Georges Point, Ronge Island (64°40'S, 62°40'W) and Hydrurga Rocks (64°08'S, 61°37'W).

Several authors have noted that sea-ice loss, with subsequent effects on krill recruitment, is likely to affect the three pygoscelid species differentially, leading to range expansions and contractions, and a reorganization of the relative proportion of each of these species (Fraser *et al.* 1992, Smith *et al.* 1999, Forcada *et al.* 2006). In years of abundant prey availability, sympatrically breeding species are able to forage and breed successfully; in years of low prey availability, interspecific competition and differential foraging success favors some species over others (Lynnes *et al.* 2002).

Our results are largely consistent with the most recent literature on pygoscelid population dynamics which, taken collectively, report on widespread and long-term Adélie declines along the Antarctic Peninsula, recent but significant declines in Chinstrap populations, and a stable or increasing population of Gentoos in all but the northwestern region of the Peninsula. Sander *et al.* (2007) report a decline in both Adélies and Chinstraps at Penguin Island in the South Shetland Islands. Forcada *et al.* (2006) report on Adélie and Chinstrap declines coincident with significant increases in the Gentoo

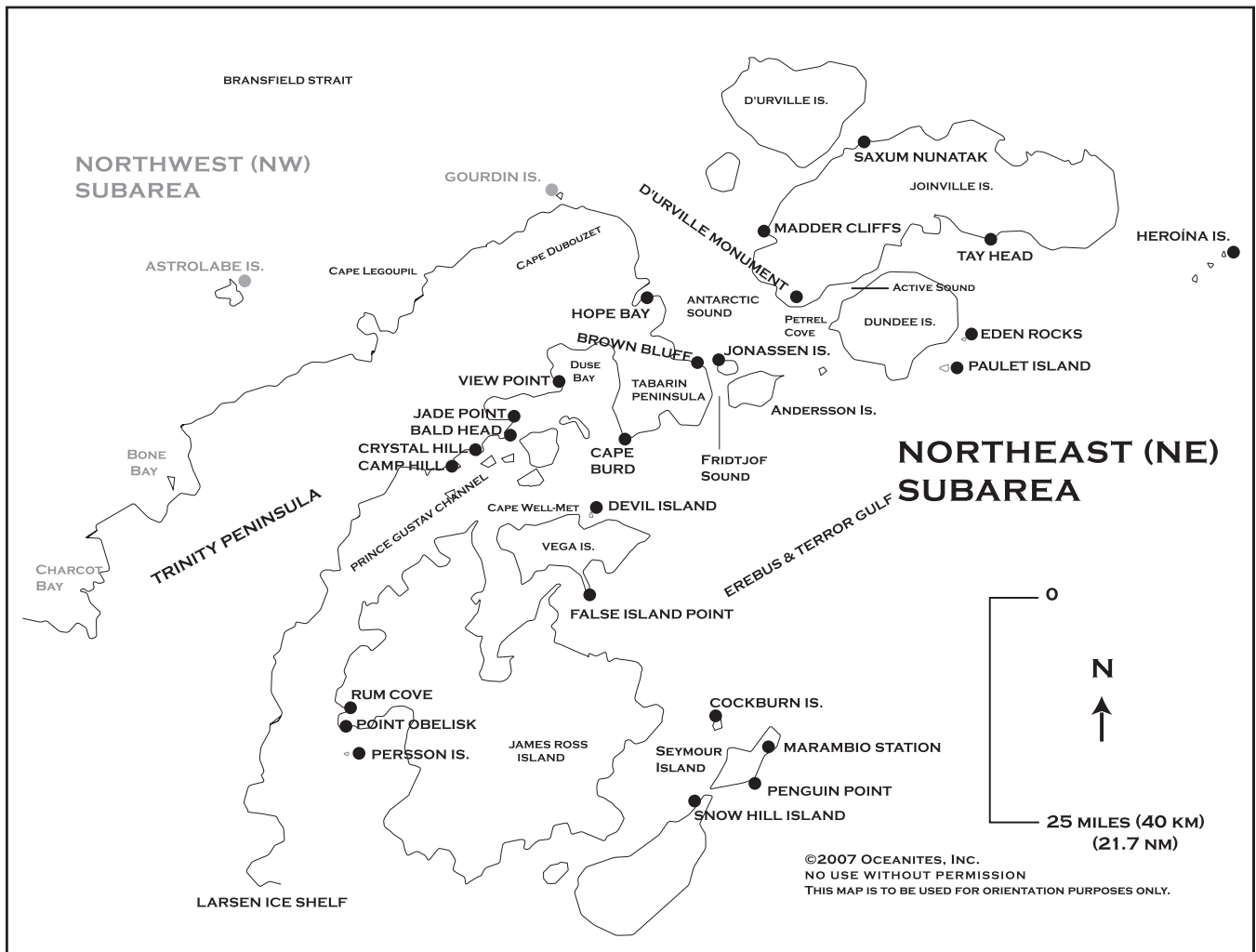


Fig. 3. Map of the Northeast Antarctic Peninsula region subarea, as defined by the Antarctic Site Inventory.



The population of Blue-eyed Shags roughly doubled at Cuverville Island (64°41'S, 62°38'W) between December 2001 and December 2004 and at Pléneau Island (65°06'S, 64°04'W) between January 2000 and January 2006, and more than doubled at Pautet Island (63°35'S, 55°47'W) between November 1999 and November 2007.

With respect to Southern Giant Petrels, we report increasing populations at two sites in the South Shetland Islands (Barrientos Island [Aitcho Islands] 62°24'23"S, 59°45'00"W, and Hannah Point [Livingston Island] 62°39'S, 60°37'W). These trends are consistent with reports of stable or increasing Southern Giant Petrel populations elsewhere on the Peninsula (Woehler & Croxall 1997), but with only two sites at which we can assess changes, we are unable to assess overall trends for this species. We note, however, that at the 2006 and 2007 Antarctic Treaty Consultative Meetings, there was vigorous discussion about listing this species as a Specially Protected Species under Annex II of the Protocol on Environmental Protection to the Antarctic Treaty ( $\lambda$ Xth Antarctic Treaty Consultative Meeting 2006, XXXth Antarctic Treaty Consultative Meeting 2007). The International Union for Conservation of Nature (IUCN) has expressed concern about this species because of longline fishing in the Southern Ocean, but the status of Southern Giant Petrels in the Antarctic Peninsula remains unclear. The Inventory is uniquely positioned to monitor this species and will continue to do so.

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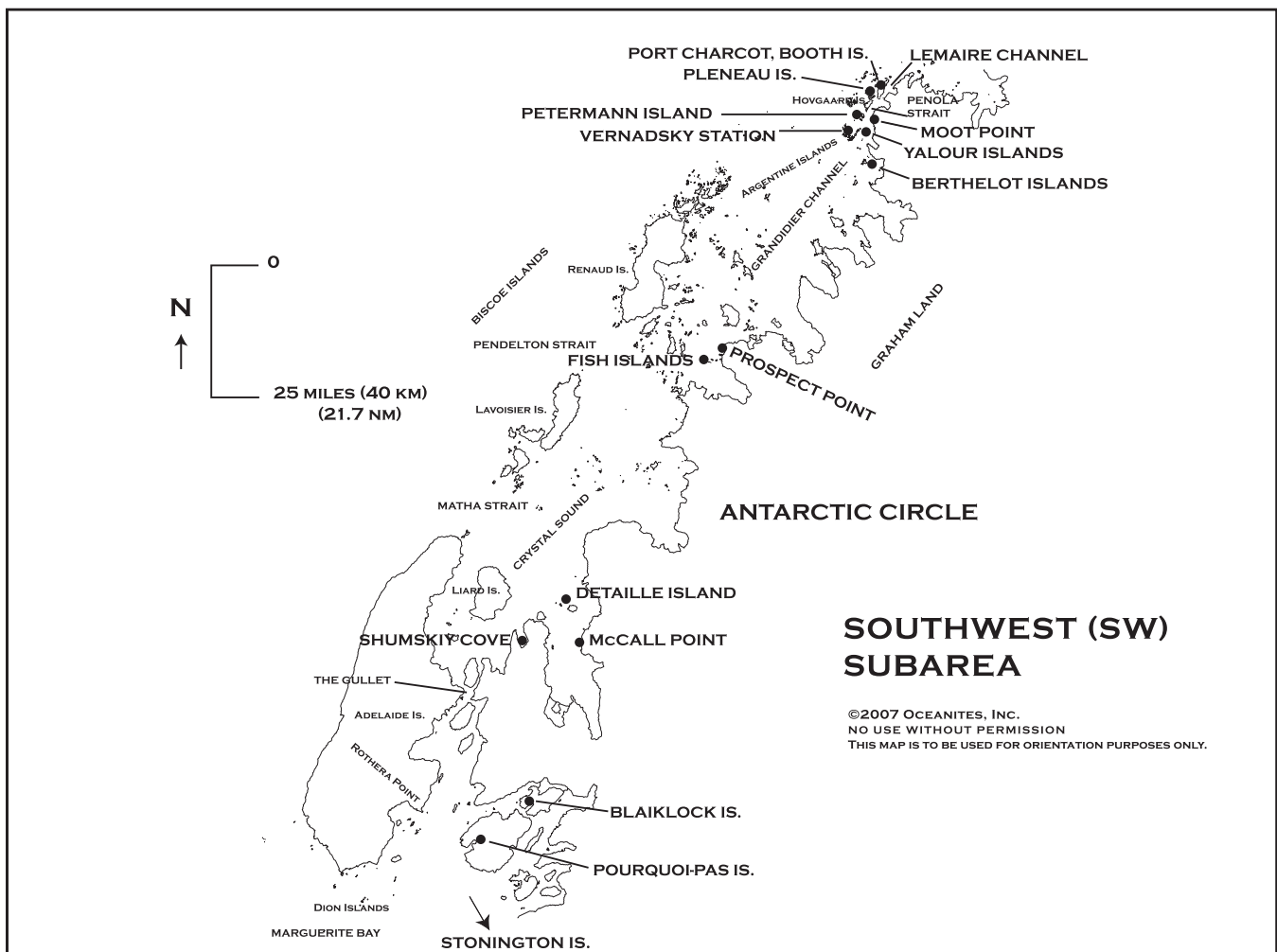
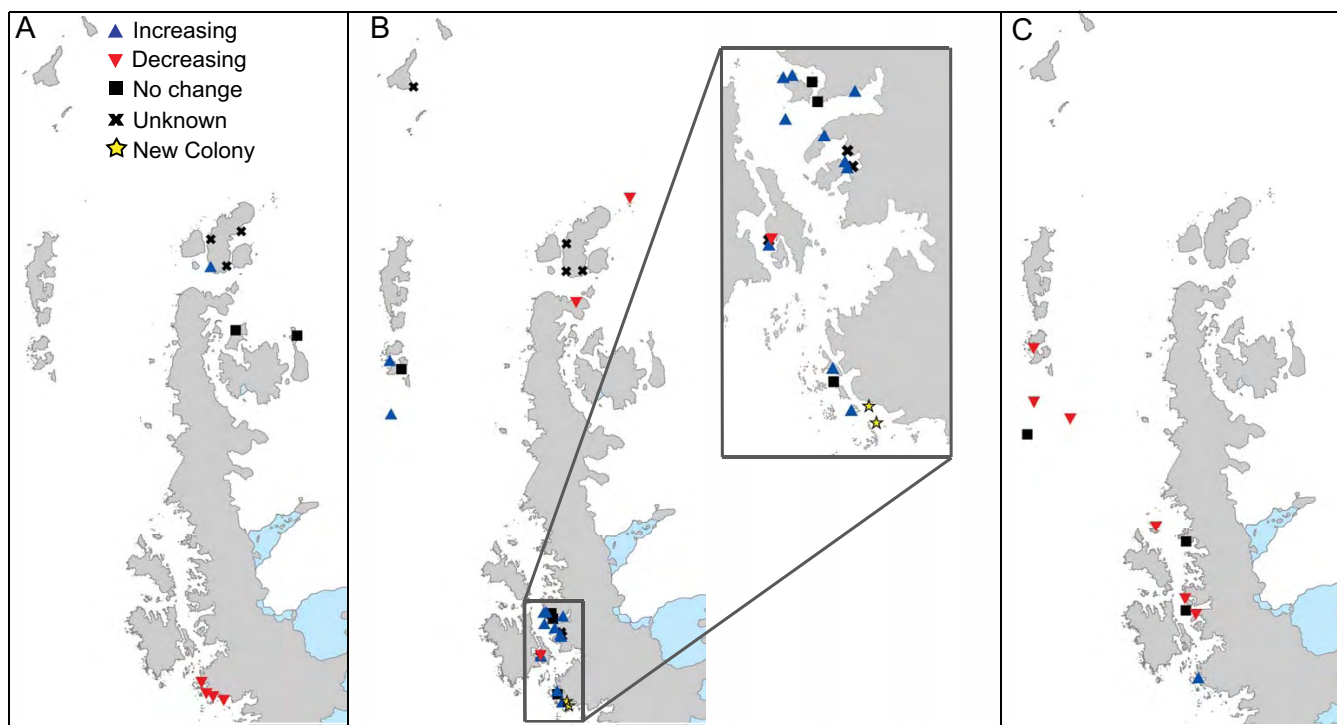


Fig. 5. Map of the Southwest Antarctic Peninsula region subarea, as defined by the Antarctic Site Inventory.

Adventures; Hapag-Lloyd Kreuzfahrten; Hurtigruten Group ASA; and Polar Star Expeditions).

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**Fig. 6.** (A) Changes in Adélie Penguin *Pygoscelis adeliae* populations. (B) Changes in Gentoo Penguin *Pygoscelis papua* populations. The southwestern region has been expanded in the inset to provide greater detail. (C) Changes in Chinstrap Penguin *Pygoscelis antarctica* populations. Filled triangle = increasing; filled inverted triangle = decreasing; filled square = no change; cross = unknown; filled star = new colony.

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**TABLE 1**  
**Antarctic Site Inventory (ASI) censuses for the Adélie Penguin *Pygoscelis adeliae*, 2001–2007**

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Marshall Bay, Coronation Island (SO) 60°39'S, 45°38'W 13 381 N3	17 Dec 2003	To be confirmed. New site for the ASI. Appears to be the first reported census at this site.	NA
Shingle Cove, Coronation Island (SO) 60°39'S, 45°34'W 3205 N1 3041 N1/N2/N3	17 Dec 2003 9 Dec 2006	No change since N4 count of 3000 in 1978 (Woehler 1993). New site for the ASI.	1.0±0.02
Devil Island (NE) 63°48'S, 57°17'W 5880 C3 8500 C3 8802 N1/N2/N3 18 000 C3	12 Jan 2002 20 Jan 2003 31 Dec 2004 13 Jan 2007	No clear trend since C3 count of 10 320 in 1996 (Naveen, unpub. data; reported in Woehler & Croxall 1997).	NA
d'Urville Monument (NE) 63°25'S, 56°18'W 10 000 N4	24 Jan 2006		NA
Penguin Point, Seymour Island (NE) 64°17'42"S, 56°41'24"W 26 400 N4	22 Dec 2006	No change since N2 count of 21 954 in 1985 (Woehler 1993). New site for the ASI.	1.01±0.02
Saxum Nunatak (NE) 63°10'S, 56°02'W 150 N4	22 Dec 2005	To be confirmed. New site for the ASI. Appears to be the first reported census at this site.	NA
Tay Head, Joinville Island (NE) 63°21'S, 55°33'W 6450 N4	21 Dec 2006	New site for the ASI. Appears to be the first reported census at this site.	NA
Berthelot Islands (SW) 65°20'S, 64°09'W 402 N1 548 C1	25 Dec 2006 16 Jan 2007	N1 count of 402 is down 69% since N1 count of 1300 in 1982 (Woehler 1993).	0.952±0.003
Booth Island (SW) 65°05'S, 64°00'W 18 N1 34 N1 17 N1 23 C1	14 Jan 2001 24 Dec 2001 4 Jan 2006 26 Jan 2006	Down >95% from estimate of >1208 (A5,C1,C3,B) in 1903–1909 (Woehler 1993). (We assume a C4 count of 1208 in 1906 to estimate $\lambda$ .)	0.961±0.005
Detaille Island (SW) 66°52'S, 66°48'W 925 C3	13 Jan 2003	No change between C3 count of 925 and C1 count of 900 in 1986 (Woehler 1993). New site for the ASI.	1.00±0.01
Fish Islands (SW) 66°02'S, 65°25'W 1634 C1/C2	13 Jan 2003	Down 59% from C3/C4 count of 4000 in 1984 (Woehler 1993).	0.95±0.03
Pléneau Island (SW) 65°06'S, 64°04'W 1 N1 1 N1	3 Jan 2003 4 Jan 2004	Further monitoring of this site is required to determine if this stray nesting pair represents a new colony of Adélie penguins at this site.	N/A
Petermann Island (SW) 65°10'S, 64°10'W 485 N1 553 N1 731 C1 532 N1 580 C1 505 N1 589 C1 410 N1 458 C1	10 Dec 2002 21 Nov 2003 24 Jan 2004 21 Nov 2004 4 Feb 2005 16 Nov 2005 27 Jan 2006 21 Nov 2006 4 Feb 2007	N1 count of 410 is down 52% from N1 count of 862 in 1997 (Naveen <i>et al.</i> 2000).	0.921±0.007
Yalour Islands (SW) 65°14'S, 64°10'W 4246 <sup>c</sup> N1 5558 C1	30 Nov 2003 27 Jan 2004	N1 count of 4246 is down 47% from N1 count of 8000 in 1982 (Woehler 1993).	0.970±0.003

<sup>a</sup> Codes: N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%; N3 = accurate estimate, accurate to 10%–15%; N4 = Rough estimate, accurate to 25%–50%; C1 = chicks individually counted, accurate to better than ±5%; C2 = chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%; C3 = accurate estimate, accurate to 10%–15%; C4 = rough estimate, accurate to 25%–50%; A1 = estimates based on counts of total birds or adults individually counted, accurate to better than ±5%; A2 = estimates based on counts of total birds or adults individually counted, accurate to 5%–10%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10%–15%; A4 = estimates based on counts of total birds or adults individually counted, accurate to 25%–50%.

<sup>b</sup> Where census error is larger than the difference between two censuses, we assume no change in population size. The annual rate of population change  $\lambda$  (and its error) is calculated as described in the text.

<sup>c</sup> Does not include approximately 25 nests on Island 11.

SO = South Orkney islands; NA = not applicable; NE = Northeast Antarctic Peninsula; SW = Southwest Antarctic Peninsula.

**TABLE 2**  
**Antarctic Site Inventory censuses for the Gentoo Penguin *Pygoscelis papua*, 2001–2007**

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Barrientos Island, Aitcho Islands (SH) 62°24'23"S, 59°45'00"W		Up 39% since N1 count of 1177 in Dec 1999 (Naveen <i>et al.</i> 2000).	1.05±0.01
1236 C1	11 Jan 2002		
1486 N1	20 Dec 2003		
1998 N1	18 Nov 2005		
2483 C1/C2	22 Jan 2006		
1639 N1	20 Dec 2006		
Hannah Point, Livingston Island (SH) 62°39'S, 60°37'W		Up 40% since N1 count of 1350 in Dec 1997 (Naveen <i>et al.</i> 2000).	1.05±0.01
1885 N1	23 Dec 2004		
Yankee Harbor, Greenwich Island (SH) 62°32'S, 59°47'W		No change since N1 count of 4751 in 1999 (Naveen <i>et al.</i> 2000).	1.01±0.02
3974 N1	24 Dec 2000		
3804 N1	29 Dec 2002		
4918 N1	20 Dec 2003		
Point Lookout (EI) 61°17'S, 55°13'W			NA
313 C1	22 Jan 2007		
Brown Bluff, Tabarin Peninsula (NE) 63°32'S, 56°55'W		N1 count of 444 is down 28% from N1 count of 617 in 1999 (Naveen <i>et al.</i> 2000).	0.95±0.01
756 N1	11 Dec 2000		
511 C1	9 Jan 2001		
450 N1	11 Dec 2001		
409 C1	24 Jan 2002		
490 N1	31 Dec 2002		
764 C1	10 Jan 2003		
200 N1	29 Nov 2003		
370 N1	24 Dec 2004		
589 C1	11 Jan 2005		
247 N1	22 Dec 2005		
118 C1	13 Jan 2006		
444 N1	19 Nov 2006		
d'Urville Monument (NE) 63°25'S, 56°18'W			NA
671 C1/C2	24 Jan 2006		
Heroina Island, Danger Islands (NE) 63°24'S, 54°36'W		Probably down from N1 count of 215 in 1996 (Naveen <i>et al.</i> 2000).	N/A
142 C1	3 Feb 2006		
Madder Cliffs, Joinville Island (NE) 63°18'S, 56°29'W		To be confirmed. New site for the ASI. Appears to be the first reported census at this site.	NA
304 N1	12 Jan 2005		
455 C1	12 Jan 2005		
Saxum Nunatak (NE) 63°10'S, 56°02'W		New site for the ASI. Appears to be the first reported census at this site.	NA
540 N4	22 Dec 2005		
Almirante Brown Station Vicinity (NW) 64°53'S, 62°52'W			NA
111 N1	16 Jan 2006		
121 C1	6 Feb 2006		
128 N1	19 Nov 2006		
Beneden Head (NW) 64°46'S, 62°42'W		No change since C1/C3 count of 500 in 1986 (Woehler 1993). New site for the ASI.	NA
640 N3	13 Dec 2006		
Bryde Island (NW) 64°52'S, 63°02'W			
See Bryde Island East and South below			
Bryde Island East (NW) 64°53'21"S, 62°55'31"W		Bryde Island South is actually a small island off the coast in the region indicated by the red box. Up 103% since N1 count of 240 in 1986 (Woehler 1993). New site for the ASI.	1.036±0.006
486 N1/N2	24 Dec 2006		
Bryde Island South (NW) 64°54'3"S, 62°57'2"W		Possibly up from C1 count of 500 in 1987 (Woehler 1993). New site for the ASI.	NA
818 N1	24 Dec 2006		
Cuverville Island (NW) 64°41'S, 62°38'W		N1 count of 6294 is up 31% since N1 count of 4818 in 1994 (Woehler and Croxall 1997).	1.025±0.007
5990 N1	21 Dec 2003		
6294 N1	2 Dec 2005		
4420 N3	4 Jan 2007		
Dorian Bay/Damoy Point (NW) 64°49'S, 63°32'W		N1 count of 2273 is up 37% since N1 count of 1658 in 1990 (Woehler 1993).	1.021±0.005
1928 N1	12 Dec 2002		
2022 N1	4 Jan 2005		
2273 N1	26 Dec 2005		
2990 C1	5 Feb 2006		
Danco Island (NW) 64°44'S, 62°37'W		No change since N2 count of 2300 in Nov 1999 (Naveen <i>et al.</i> 2000).	1.01±0.02
2506 N1	8 Dec 2006		

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Dori Beacon (NW) 64°48'42"S, 63°30'42"W		New site for the ASI. Appears to be the first reported census at this site.	NA
132 N1	15 Jan 2005		
181 N1	26 Dec 2005		
257 C1	5 Feb 2006		
Georges Point, Rongé Island (NW) 63°12'S, 57°18'W		N1 count of 2464 is up 41% since N2 count 1752 in 1994 (Woehler and Croxall 1997).	1.03±0.01
1995 N1	20 Dec 2004		
2464 N1	26 Dec 2005		
Jougla Point/Port Lockroy (NW) 64°49'S, 63°30'W		N1 count of 1282 is down 24% since N1 count of 1681 in 1999 (Naveen <i>et al.</i> 2000).	0.96±0.01
1556 N1	9 Dec 2002		
1621 C1	25 Jan 2003		
1540 N1	5 Jan 2004		
2043 C1	16 Feb 2004		
1306 N1	20 Dec 2004		
1409 N1	26 Dec 2005		
1925 C1	27 Jan 2006		
1282 N1	22 Nov 2006		
1684 C1	28 Jan 2007		
Neko Harbor, Andvord Bay (NW) 64°50'S, 62°33'W		N1/N2/N3 count of 1153 is up 37% since N1 count of 844 in 1999 (Naveen <i>et al.</i> 2000).	1.05±0.02
1072 N1	11 Dec 2002		
1088 N1	21 Dec 2003		
1096 N1	14 Dec 2004		
1301 N1	3 Dec 2005		
1726 C1	28 Jan 2006		
1153 N1/N2/N3	13 Dec 2006		
Paradise Harbor Beacon, Paradise Bay (NW) 64°54'40"S, 62°55'52"W		New site for the ASI. Appears to be the first reported census at this site.	NA
3 N1	24 Dec 2006		
Useful Island (NW) 64°43'S, 62°52'W		Up >1500% over N3N/4 count of 150 in 1984 (Woehler 1993). New site for the ASI.	1.13±0.03
1861 N1	3 Jan 2005		
Waterboat Point, Paradise Bay (NW) 64°49'S, 62°51'W		This represents a significant increase since C1 count of 750 in 1986 (Woehler 1993).	NA
2122 N2	4 Dec 2004		
Port Charcot, Booth Island (SW) 65°05'S, 64°00'W		N3 count of 1200 is up 300% since N1 count of 400 in 1983 (Woehler 1993).	1.063±0.009
1200 N3	13 Jan 2001		
1151 N1/N3	4 Jan 2006		
Moot Point (SW) 65°12'S, 64°06'W		This represents a new breeding colony of Gentoos. New site for the ASI. Appears to be the first reported census at this site.	NA
74 N1	24 Nov 2005		
101 N1	25 Dec 2006		
Pléneau Island (SW) 65°06'S, 64°04'W		No change since N1 count of 1577 in 1999 (Naveen <i>et al.</i> 2000).	1.00±0.01
1579 N1	13 Dec 2000		
1639 N1	3 Jan 2003		
2170 N1	22 Dec 2003		
2135 N1	4 Jan 2005		
1574 N1	5 Jan 2007		
Petermann Island (SW) 65°10'S, 64°10'W		N1 count of 2293 is up 47% since N1 count of 1224 in 1997 (Naveen <i>et al.</i> 2000).	1.072±0.008
2212 N1	17 Jan 2004		
3260 C1	24 Jan 2004		
2301 N1	4 Dec 2004		
2781 C1	23 Jan 2005		
2438 N1	2 Dec 2005		
3453 C1	25 Jan 2006		
2293 N1	24 Nov 2006		
3344 C1	2 Feb 2007		
Yalour Islands (SW) 65°14'S, 64°10'W		This represents a new breeding colony of Gentoos and the southernmost location ever reported for Gentoos along the Antarctic Peninsula.	NA
15 N1	25 Dec 2006		

<sup>a</sup> Codes: N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%; N3 = accurate estimate, accurate to 10%–15%; N4 = Rough estimate, accurate to 25%–50%; C1 = chicks individually counted, accurate to better than ±5%; C2 = chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%; C3 = accurate estimate, accurate to 10%–15%; C4 = rough estimate, accurate to 25%–50%; A1 = estimates based on counts of total birds or adults individually counted, accurate to better than ±5%; A2 = estimates based on counts of total birds or adults individually counted, accurate to 5%–10%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10%–15%; A4 = estimates based on counts of total birds or adults individually counted, accurate to 25%–50%.

<sup>b</sup> Where census error is larger than the difference between two censuses, we assume no change in population size. The annual rate of population change  $\lambda$  (and its error) is calculated as described in the text.

SH = South Shetland Islands; EI = Elephant Island and nearby islands; NE = Northeast Antarctic Peninsula; NW = Northwest Antarctic Peninsula; SW = Southwest Antarctic Peninsula.

**TABLE 3**  
**Antarctic Site Inventory (ASI) censuses for the Chinstrap Penguin *Pygoscelis antarctica*, 2001–2007**

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Sandefjord Bay (SO) 60°37'S, 46°03'W 125000 A4	28 Nov 2003	New site for the ASI. Appears to be the first reported census at this site.	NA
Cecilia Island, Aitcho Islands (SH) 62°24'43"S, 59°43'53"W 14 N1	11 Jan 2006	Down >99% from N4 count of 3500 in 1966 (Woehler 1993). New site for the ASI.	0.87±0.01
Entrance Point (SH) 63°00'S, 60°33'W 566 N1 736 C1 902 N1	23 Dec 2005 25 Jan 2006 21 Nov 2006	N1 count of 902 is down 55% since N3 count of 2010 in 1967 (Woehler 1993). New site for the ASI.	0.980±0.004
Hannah Point, Livingston Island (SH) 62°39'S, 60°37'W 759 N1	23 Dec 2004	Down 49% since N3 count of 1500 in 1987 (Woehler 1993).	0.961±0.009
President Head, Snow Island (SH) 62°44'S, 61°12'W 23 N1	21 Nov 2005	No change since A4 count of 50 in 1987 (Woehler 1993). New site for the ASI.	1.00±0.03
Point Wild/Cape Belsham (EI) 61°06'S, 54°52'W 10000 N3	10 Dec 2006	Count includes all of Point Wild and Cape Belsham together.	NA
Eckener Point (NW) 64°26'S, 61°36'W 30 N1	13 Dec 2006	No change since N3/N4 count of 40 in 1987 (Woehler 1993). New site for the ASI.	0.98±0.02
Georges Point, Ronge Island (NW) 64°40'S, 62°40'W 356 N1 269 N1 246 N1 399 C1 260 N1 354 C1	12 Jan 2001 20 Dec 2004 26 Dec 2005 5 Feb 2006 22 Nov 2006 26 Jan 2007	N1 count of 260 is down 20% since N1 count of 327 in 1998 (Naveen <i>et al.</i> 2000).	0.972±0.009
Hydrurga Rocks (NW) 64°08'S, 61°37'W 417 N1 448 N1	26 Dec 2000 1 Jan 2003	N1 count of 448 is down 15% since N1 count of 526 in 1996 (Naveen <i>et al.</i> 2000).	0.97±0.01
Orne Islands (NW) (All on island 2) 64°39'S, 62°40'W 396 N1 634 C1 106 N1 111 C1 338 N1 472 C1 350 N1 489 C1 447 C1	14 Dec 2000 23 Jan 2001 24 Dec 2001 15 Feb 2002 9 Dec 2002 14 Feb 2003 22 Nov 2005 5 Feb 2006 26 Jan 2007	N1 count of 350 in Nov 2005 is down 17% since N1 count of 421 in Nov 1999 (Naveen <i>et al.</i> 2000).	0.97±0.01
Useful Island (NW) 64°43'S, 62°52'W 160 N1	3 Jan 2005	No change since N3/N4 count of 100 in 1984 (Woehler 1993). New site for the ASI.	1.02±0.03
Waterboat Point, Paradise Bay (NW) 64°49'S, 62°51'W 0 N1	3 Jan 2005	This represents the local disappearance of Chinstraps at this site, which recently has had a declining population over the last two decades: N1 = 4 in 1998 (Naveen, unpub. data); N1 = 28 in 1989 (Woehler 1993).	NA
Booth Island (SW) 65°05'S, 64°00'W 12 N1 17 C1 24 N1 9 N1 12 C1 13 C1	13 Jan 2001 24 Jan 2001 24 Dec 2001 4 Jan 2006 26 Jan 2006 15 Feb 2007	Generally up since C1 count of 3 in 1983 and N1 count of 3 in 1990 (Woehler 1993).	1.076±0.005

<sup>a</sup> Codes: N1 = nests individually counted, accurate to better than ±5%; N2 = nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%; N3 = accurate estimate, accurate to 10%–15%; N4 = Rough estimate, accurate to 25%–50%; C1 = chicks individually counted, accurate to better than ±5%; C2 = chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%; C3 = accurate estimate, accurate to 10%–15%; C4 = rough estimate, accurate to 25%–50%; A1 = estimates based on counts of total birds or adults individually counted, accurate to better than ±5%; A2 = estimates based on counts of total birds or adults individually counted, accurate to 5%–10%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10%–15%; A4 = estimates based on counts of total birds or adults individually counted, accurate to 25%–50%.

<sup>b</sup> Where census error is larger than the difference between two censuses, we assume no change in population size. The annual rate of population change  $\lambda$  (and its error) is calculated as described in the text.

SO = South Orkney islands; NA = not applicable; SH = South Shetland Islands; EI = Elephant Island and nearby islands; NW = Northwest Antarctic Peninsula.

**TABLE 4**  
**Antarctic Site Inventory (ASI) censuses for the Blue-eyed Shag *Phalacrocorax atriceps*, 2001–2007**

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Hannah Point, Livingston Island (SH) 62°39'S, 60°37'W		Down 20% since N1 count of 5 in 1999 (Naveen <i>et al.</i> 2000).	0.96±0.0
3 N1	15 Dec 2000		
4 N1	23 Dec 2004	1	
Whaler's Bay, Deception Island (SH) 62°59'S, 60°34'W			NA
10 N1	13 Jan 2005		
17 C1	13 Jan 2005		
8 N1	23 Dec 2005		
Active Reef, Active Sound (NE) 63°23'S, 55°52'W		New site for the ASI.	NA
20 A5	21 Dec 2006		
Cockburn Island (NE) 64°12'S, 56°51'W		New site for the ASI.	NA
800 N5	19 Nov 2006		
Almirante Brown Station Vicinity (NW) 64°53'S, 62°52'W		N1 count of 75 is up 53% since N1 count of 49 in 2000 (Naveen <i>et al.</i> 2000). After declining for several years in the 1990s (Naveen <i>et al.</i> 2000), the N1 count of 45 in 2001 was the lowest point for this population, and the population has been generally increasing over the period we report here.	1.06±0.01
45 N1	13 Dec 2001		
63 N1	11 Dec 2002		
114 C1	25 Jan 2003		
73 N1	2 Dec 2003		
78 N1	14 Dec 2004		
104 C1	14 Jan 2005		
71 N1	2 Dec 2005		
75 N1	22 Nov 2006		
Paulet Island (NE) 63°35'S, 55°47'W		N1/N2 count of 804 in Nov. 2006 is up 113% since N2 count of 377 in Nov. 1999 (Naveen <i>et al.</i> 2000).	1.11±0.02
291 N1	25 Dec 2000		
279 C1	9 Jan 2001		
321 N1	21 Dec 2001		
273 N1	10 Jan 2003		
524 C2	20 Jan 2003		
534 N1	24 Dec 2004		
413 N1	20 Nov 2005		
327 A1	13 Jan 2006		
804 N1/N2	19 Nov 2006		
465 C2	18 Feb 2007		
Beneden Head (NW) 64°46'S, 62°42'W		New site for the ASI.	NA
20 N3	22 Nov 2006		
Cuverville Island (NW) 64°41'S, 62°38'W		N1 count of 29 in Nov 2006 is up 141% from N1 count of 12 in Dec 2001.	1.19±0.02
13 N1	23 Jan 2001		
33 C1	23 Jan 2001		
12 N1	13 Dec 2001		
28 N1	2 Jan 2003		
40 C1	14 Feb 2003		
26 N1	21 Dec 2003		
21 N1	13 Dec 2004		
30 C1	14 Jan 2005		
23 N1	26 Dec 2005		
29 N1	22 Nov 2006		
Hydrurga Rocks (NW) 64°08'S, 61°37'W			NA
11 N1	3 Jan 2002		
13 C1	3 Jan 2002		
12 N1	11 Jan 2003		
Jougla Point/Port Lockroy (NW) 64°50'S, 63°30'W		No change between N1 count of 26 in Jan. 2007 and N1 count of 26 in Jan. 2000.	1.01±0.01
26 N1	13 Dec 2000		
43 C1	4 Feb 2001		
23 N1	25 Dec 2001		
26 C1	28 Jan 2002		
32 N1	9 Dec 2002		
62 C1	25 Jan 2003		
28 N1	1 Dec 2003		
46 C1	16 Feb 2004		
29 N1	13 Dec 2004		
43 C1	16 Jan 2005		
20 N1	26 Dec 2005		
46 C1	27 Jan 2006		
26 N1	28 Jan 2007		
44 C1	28 Jan 2007		

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Lecointe Island (NW) 64°16'S, 62°03'W		New site for the ASI.	NA
7 N1	23 Dec 2001		
4 N1	12 Dec 2002		
Orne Islands (NW) 64°39'S, 62°40'W		Although there were 15 active nests in Dec 1994 (Naveen <i>et al.</i> 2000), the Blue-eyed Shag population on the Orne Islands went extinct in 1999 and, as reported here, has not been reestablished.	NA
0 N1	14 Dec 2000		
0 C1	23 Jan 2001		
0 N1	15 Feb 2002		
0 C1	15 Feb 2002		
0 N1	22 Nov 2005		
0 N1	22 Nov 2006		
Priest Island, Peltier Channel (NW) 64°52'S, 63°31'W		New site for the ASI.	NA
8 N1	14 Dec 2001		
Useful Island (NW) 64°43'S, 62°52'W		To be confirmed. New site for the ASI.	NA
17 N1	3 Jan 2005		
Berthelot Islands (SW) 65°20'S, 64°09'W			NA
96 N1	25 Dec 2006		
Detaille Island (SW) 66°52'S, 66°48'W		New site for the ASI.	NA
3 C1	13 Jan 2003		
3 N1	3 Jan 2004		
Fish Islands (SW) 66°02'S, 65°25'W			NA
31 N1	13 Jan 2003		
Pléneau Island (SW) 65°06'S, 64°04'W		N1 count of 58 in Dec 2006 is up 115% since N1 count of 27 in Dec 2000.	NA
27 N1	13 Dec 2000		
53 C1	24 Jan 2001		
18 N1	4 Jan 2002		
18 C1	15 Jan 2002		
28 N1	3 Jan 2003		
27 C1	14 Jan 2003		
38 N1	22 Dec 2003		
73 C1	15 Jan 2004		
36 N1	4 Jan 2005		
58 N1	14 Dec 2006		
Petermann Island (SW) 65°10'S, 64°10'W		N1 count of 13 in Nov. 2006 is down 55% since N1 count of 29 in Nov 1997 and C1 count of 29 in Jan 2007 is down 37% since C1 count of 46 in Jan 2000 (Naveen <i>et al.</i> 2000).	0.915±0.007
19 N1	15 Nov 2004		
37 C1	25 Jan 2005		
11 N1	16 Nov 2005		
26 C1	16 Jan 2006		
13 N1	4 Nov 2006		
29 C1	12 Jan 2007		
Stonington Island (SW) 68°11'S, 67°00'W		New site for the ASI.	N/A
135 C1	6 Feb 2007		
Yalour Islands (SW) 65°14'S, 64°10'W			NA
16 N1	27 Jan 2004		
40 C1	27 Jan 2004		
18 N1	25 Dec 2006		

<sup>a</sup> Codes: N1 = nests individually counted, accurate to better than  $\pm 5\%$ ; N2 = nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%; N3 = accurate estimate, accurate to 10%–15%; N4 = Rough estimate, accurate to 25%–50%; C1 = chicks individually counted, accurate to better than  $\pm 5\%$ ; C2 = chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%; C3 = accurate estimate, accurate to 10%–15%; C4 = rough estimate, accurate to 25%–50%; A1 = estimates based on counts of total birds or adults individually counted, accurate to better than  $\pm 5\%$ ; A2 = estimates based on counts of total birds or adults individually counted, accurate to 5%–10%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10%–15%; A4 = estimates based on counts of total birds or adults individually counted, accurate to 25%–50%.

<sup>b</sup> Where census error is larger than the difference between two censuses, we assume no change in population size. The annual rate of population change  $\lambda$  (and its error) is calculated as described in the text.

SH = South Shetland Islands; NA = not applicable; NE = Northeast Antarctic Peninsula; NW = Northwest Antarctic Peninsula; SW = Southwest Antarctic Peninsula.

**Table 5**  
**Antarctic Site Inventory (ASI) censuses for the Southern Giant Petrel *Macronectes giganteus***

Census <sup>a</sup>	Date	Notes	Annual rate of change ( $\lambda$ ) <sup>b</sup>
Barrientos Island, Aitcho Islands (SH) 62°24'23"S, 59°45'00"W		N1 count of 144 is up 33% since N1 count of 108 in 1999.	1.04±0.01
153	C1	12 Dec 2001	
156	N1	11 Jan 2002	
142	N1	20 Dec 2003	
164	N1	10 Jan 2005	
143	N1	29 Nov 2005	
144	N1	18 Nov 2006	
Cecilia Island, Aitcho Islands (SH) 62°24'43"S, 59°43'53"W		New site for the ASI.	NA
100	N1	11 Jan 2006	
Hannah Point, Livingston Island (SH) 62°39'S, 60°37'W		N1 count of 142 is up 28% since N1 count of 111 in 2000 (Naveen <i>et al.</i> 2000).	1.06±0.02
123	N1	15 Dec 2000	
142	N1	2 Jan 2005	
President Head, Snow Island (SH) 62°44'S, 61°12'W		New site for the ASI.	NA
40	N4	21 Nov 2005	

<sup>a</sup> Codes: N1 = nests individually counted, accurate to better than  $\pm 5\%$ ; N2 = nests counted in a known area, and then extrapolated over total colony area, accurate to 5%–10%; N3 = accurate estimate, accurate to 10%–15%; N4 = Rough estimate, accurate to 25%–50%; C1 = chicks individually counted, accurate to better than  $\pm 5\%$ ; C2 = chicks counted in a known area, and then extrapolated over total area, accurate to 5%–10%; C3 = accurate estimate, accurate to 10%–15%; C4 = rough estimate, accurate to 25%–50%; A1 = estimates based on counts of total birds or adults individually counted, accurate to better than  $\pm 5\%$ ; A2 = estimates based on counts of total birds or adults individually counted, accurate to 5%–10%; A3 = estimates based on counts of total birds or adults individually counted, accurate to 10%–15%; A4 = estimates based on counts of total birds or adults individually counted, accurate to 25%–50%.

<sup>b</sup> Where census error is larger than the difference between two censuses, we assume no change in population size. The annual rate of population change  $\lambda$  (and its error) is calculated as described in the text.

SH = South Shetland Islands; NA = not applicable.

