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Status and Trends of Antarctic Seabirds at Admiralty Bay, King George Island

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Abstract: This is a comparative study on the distribution, abundance and density of birds in Admiralty Bay on King George Island, Antarctica, excluding the area called ASPA 128. The survey was carried out during the breeding season of 2004/05. All data pertaining to populations of breeding birds were obtained after defining procedures and registering nests. Abundance and density calculations were made for all ice-free areas having breeding species. For comparison and assessment of the final status of birds in the bay, we used the work by Jablonski (1986) undertaken in 1978/79. Of the eight species evaluated, four had a significant population reduction: *Pygoscelis antarctica, Macronectes giganteus, Phalacrocorax atriceps,* and *Sterna vittatta;* two species, *Daption capense* and *Chionis alba,* remained stable, while *Catharacta* sp and *Larus dominicanus* had a population increase.

Zusammenfassung: Es handelt sich um eine vergleichende Studie über Verteilung, Vorkommen und Häufigkeit der Vögel in der Baia do Almirantado (Almirantado-Bucht) auf der König-Georg-Insel in der Antarktis, unter Ausschluss des Gebietes de ASPA 128. Die Untersuchungen vor Ort wurden während der Brutzeit 2004/2005 durchgeführt. Alle Daten, die sich auf die Vorkommen brütender Vögel beziehen, wurden nach einer Gesamtauflistung aller brütenden Vögel und der registrierten Nester aufgenommen. Die Berechnungen über Vorkommen und Dichte wurden für alle eisfreien Gebiete angestellt, in denen sich nistende Arten befinden. Für Vergleich und Auswertung des Vogelbestandes der Bucht wurden die Arbeiten von Jablonski (1986) hinzugezogen, die 1978/1979 durchgeführt wurden. Von den acht beobachteten Arten weisen vier einen deutlichen Rückgang auf: *Pygoscelis antarctica; Macronectes giganteus, Phalacrocorax atriceps* und *Sterna vittata.* Die beiden Arten *Daption capense* und *Chionis alba* sind gleich geblieben und *Catharacta sp* und *Larus dominicanus* haben zahlenmäßig zugenommen.

INTRODUCTION

Admiralty Bay is the largest bay located on King George Island (Fig. 1), being considered as an ASMA (Antarctic Specially Managed Area); it also includes the presence of an ASPA (Antarctic Specially Protected Area, No. 128 - forming SSSI No. 8). The entire bay presents approximately 30.4 km^2 of ice-free areas and according to Myrcha (1993), 13 breeding species can be recorded and five can be occasional visitors.

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Five nations have developed researches in the area. Poland and Brazil maintain two permanent stations; Peru and USA, summer stations; and Ecuador has one refuge. The first scientific station was Base G, which belonged to Great Britain and was abandoned in the late 1960's. From that time until the late 1970's, the bay was visited sporadically by researchers and only in 1977 was the Polish Station (Henryk Arctowski) established. The Brazilian station (Comandante Ferraz) was established in 1984.

The first ornithological studies performed in Admiralty Bay were those by Gain (1914), Conroy (1975), and Croxall & Kirkwood (1979). Only with the settlement of the Polish Station, in 1977, have long-term studies on birds been carried out by the Americans Trivelpiece & Volkman (1979), along with sporadic studies by the Poles Jablonski (1986), Myrcha (1993), and the Brazilians Petry & Sander (1987).

Many factors can be responsible for changes in breeding populations of birds in Antarctica. A major part of these are related to the increase in tourism and research activities, climate variability, glacial retreat and principally the decrease in available resources.

The research on Bird Island with breeding skuas explains that resources become even increasingly limited; and this is supported by evidence that egg-laying dates are occurring later, hatching and flying success lower, and chick growth rates poorer than in the mid-1980s (Phillips et al. 2004). Populations of *Pygoscelis* can also be affected by the low level of krill *(Euphausia superba),* important food item, arising from the diminution of sea-ice conditions (Siegel 2005).

During the summers of 1991/93, Donachie (1993) registered the presence of 26 ships with a total of 5446 tourists. Probably, these factors, in addition to weather and food changes (Loeb et al. 1997), may account for changes in the population of breeding birds in Admiralty Bay. Understanding the situation is the key to being able to monitor changes and being sure about the right measures for preservation. Hence, suitable information on the distribution and size of populations is necessary (Bó & Copello 2001).

Here, we intend to present an analysis of distribution, abundance and densities of the breeding bird populations found in Admiralty Bay during the 2004/05 breeding season in comparison with the first full records about nesting and bird distribution in the bay carried out by Jablonski (1986).

MATERIAL AND METHODS

The present work was carried out in all ice-free areas in Admiralty Bay, King George Island, South Shetland Islands, Antarctica (Figs. 1, 2) during the 2004/05 breeding season. Samples were obtained in the 17.16 km^2 geographical area, excluding data from ASPA and Point Thomas.

Starting in early November 2004 and ending in early March 2005, all ice free areas within Admiralty Bay (except ASPA and Point Thomas) were surveyed one to three times per week. During these surveys breeding pairs of flying birds were identified, and when a clutch was initiated, nests bowls were marked using a hand-held GPS receiver (E-trex, Garmin) with a mean accuracy of ±6 m. Nests of relayed clutches were not included in this analysis to assure that breeding pairs were not double counted.

In order to elaborate this work no distinctions were made between *C. antarctica lonnbergi* and *C. maccormicki,* being both considered only as skuas.

For colonial population censuses were conducted during late November to early December. We used two techniques to measure the total breeding population: i) a count of active nests, done by three observers; and ii) digital still photographs with post counting of the number of active nests. The total population was determined for each ice-free area by averaging all total counts that differed less than 10 %.We recorded only the area surrounding the colony, due to the impossibility of individual marking.

For mapping the distribution of species, the data were plotted on a geographical chart using the ArcView 8.1 software. Abundance and density calculations were made for all ice-free areas.

Historic data from 1978/79 of seabird populations at these sites were obtained from Jablonski (1986). This data was utilized with a view to make comparisons of abundance and density of actual populations with those by the past.

For this comparison of densities with previous data (Jablonski 1986), the current geographical values of the areas were used. These values were provided by Núcleo de Pesquisas Antárticas e Climáticas (NUPAC) at the Universidade Federal do Rio Grande do Sul (UFRGS), Brazil.

RESULTS

Pygoscelis antarctica

Of the flightless birds, only the chinstrap penguin uses Chabrier Rock and Shag Island as reproductive areas. A total of 1082 breeding pairs were found for all ice-free areas visited in Admiralty Bay (Tab. 1). They were at three geographical locations: Shag Island (246), Chabrier Rock (833), and

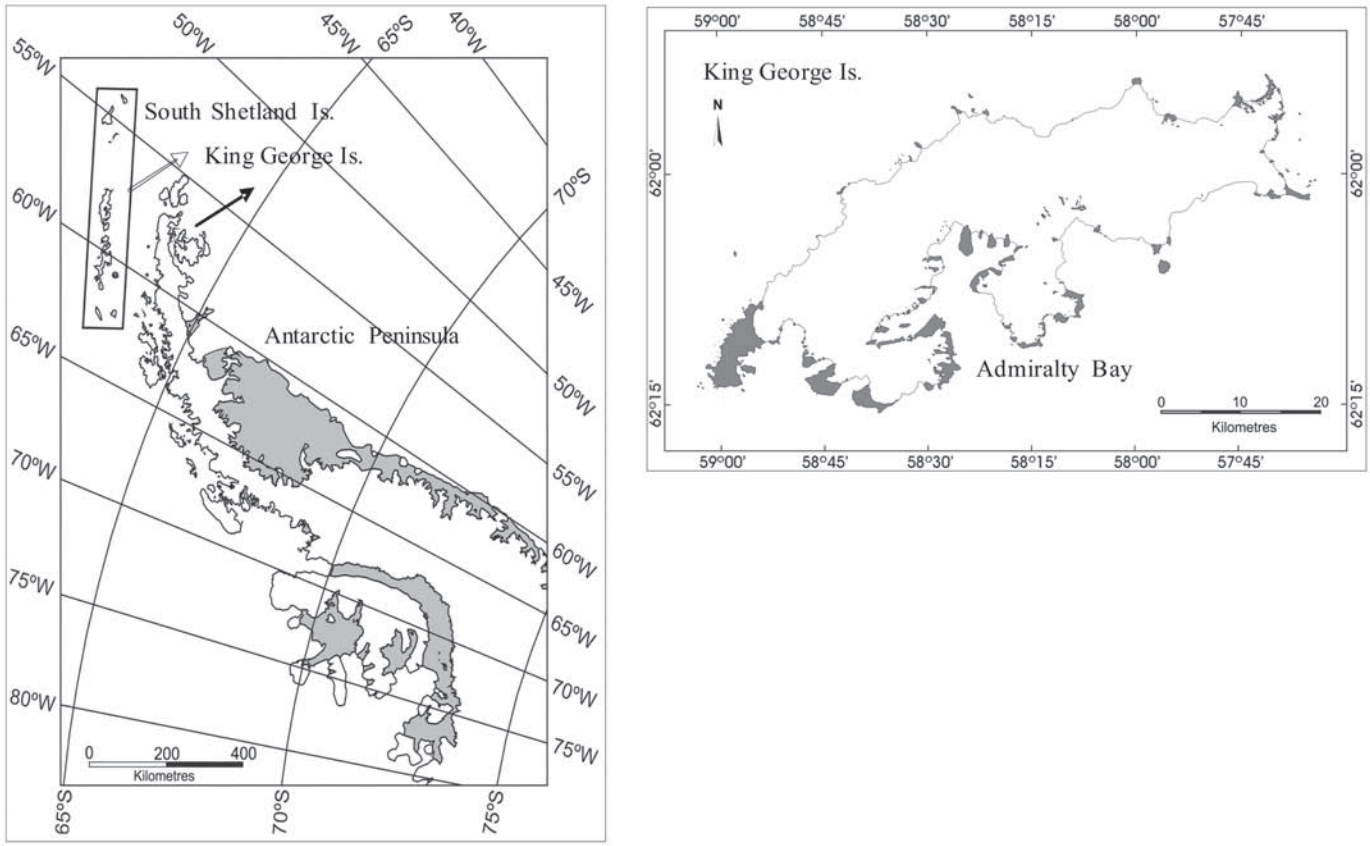

Fig. 1: Location map of Admiralty Bay on King George Island (right) and King George Island as part of South Shetland Islands relative to the Antarctic Peninsula (left).

Abb. 1: Lage der Almirantado-Bucht auf der König-Georg-Insel (rechte Karte) und Lage der König-Georg-Insel als Teil der Süd-Shetland-Inseln nahe der Antarktischen Halbinsel (linke Karte).

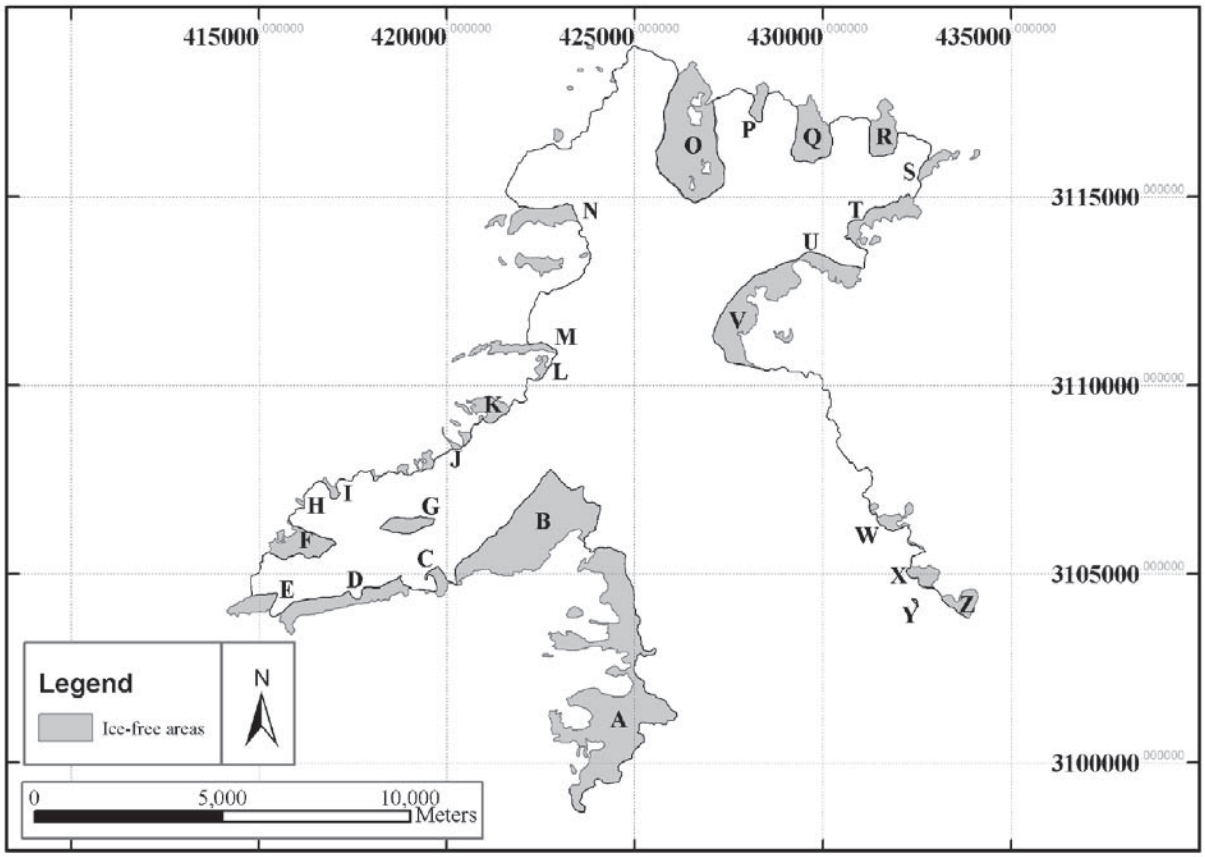

Fig. 2: Ice free areas of Admiralty Bay (A = SSSI number 8; B = Point Thomas; C = Breccia Crag; D = Cytadela; E = Belweder; F = Point Hill; G = Dufayel Island; H = Cardoso Cove; I = Emerald Point; J = Lis Point; K = Urabnek Crag; L = Denais Stack; M = Klekowski Crag; N = Crépin Point; O = Keller Peninsula; P = Stenhouse Bluff; Q = Cordillera Ullman; R = Promotório Negro Notable; S = Ternyck Needle; T = Szafer Ridge; U = Waikocz; V = Hennequin Point; W = Rembiszewski Nunataks; X = Vaureal Peak; Y = Chabrier Rock; Z = Harnasia Hill). Areas with breeding species: *Pygoscelis antarctica* (X, Y and Shag Island); *Macronectes giganteus* (D); *Daption capense* (Y); *Larus dominicanus* (G, I, O, P, Q, T, U, V, Z); *Catharacta* sp (I, N, O, P, Q, T, U, V, X); *Sterna vittata* (G, O, P, Q, T, U, X); *Chionis alba* (Y, Z).

Abb. 2: Eis freie Gebiete an der Almirantado-Bucht (A = SSSI number 8; B = Point Thomas; C = Breccia Crag; D = Cytadela; E = Belweder; F = Point Hill; G = Dufayel Island; H = Cardoso Cove; I = Emerald Point; J = Lis Point; K = Urabnek Crag; L = Denais Stack; M = Klekowski Crag; N = Crépin Point; O = Keller Peninsula; P = Stenhouse Bluff; Q = Cordillera Ullman; R = Promotório Negro Notable; S = Ternyck Needle; T = Szafer Ridge; U = Waikocz; V = Hennequin Point; W = Rembiszewski Nunataks; X = Vaureal Peak; Y = Chabrier Rock; Z = Harnasia Hill).
Gebiete mit brütenden Vögel: *Pygoscelis antarctica* (X, Y und Shag Island); *Macronectes giganteus* (D); *Daption capense* (Y); *Larus dominicanus* (G, I, O, P, Q, T, U, V, Z); *Catharacta* sp (I, N, O, P, Q, T, U, V, X); *Sterna vittata* (G, O, P, Q, T, U, X); *Chionis alba* (Y, Z).

Species	1978/ 1979	Density 1	Area (km^2)	2004/ 2005	Density 2	Area (km^2)	Variation (%)
Pygoscelis antarctica	3,325	193.76	0.02	1,082	63.05	0.02	-67.46
Macronectes giganteus	113	6.59	0.33	10	0.58	1.26	-91.15
Daption capense	3	0.17	0.01	8	0.47	0.01	166.67
Phalacrocorax atriceps	92	5.36	0.01	30	1.75	0.01	-67.39
Larus dominicanus	105	6.12	10.04	144	8.39	10.60	37.14
Catharacta sp.	50	2.91	10.53	338	19.70	10.85	576.00
Sterna vittata	246	14.34	11.83	38	2.21	8.09	-84.55
Chionis alba	3	0.17	0.01	4	0.23	0.01	33.33

Tab. 1: Abundance and nesting density in ice free areas (km^2) in the Admiralty Bay region excluding the area called ASPA. Density is related to the total area of study (17.16 km^2).

Tab. 1: Häufigkeit und Dichte der Brutplätze in Eis freien Gebieten (km^2) der Almirantado-Bucht ohne das ASPA-128-Gebiet. Die Dichte ist bezogen auf das gesamte Untersuchungsgebiet von 17.16 km^2.

Vaureal Peak (3) (Fig. 2). The general density for this breeding season was 63.05 nests km^{-2}. During 1978/79: 3325 nests were found at Chabrier Rock and Shag Island. However, the values found in JABLONSKI'S (1986) tables differ from the values shown on the maps, which indicate 3114 breeding pairs. Following those tables the general density occupied by these birds in the bay results in 193.76 nests km^{-2}. The comparison between both seasons suggests a decrease by 67.46 % in the abundance of the species for the bay.

Recent data (post-1990) suggest decreases in these populations in the Antarctic Peninsula and associated island groups (WOEHLER & CROXALL 1997). In accordance with FRASER et al. (1992), this species is reducing in Admiralty Bay, confirming the results that we found. This decline in chinstrap penguin populations seems to be related to the potential effects of

climate change on the availability of Antarctic Krill *(Euphausia superba),* the main food source of this species.

Macronectes giganteus

This is the species (Tab. 1) that presents the largest sensitivity to human disturbance in relation to other species that nest on King George Island (Prevost 1958, Roby et al. 1986, Croxall 1987). Their global decrease, very often, is attributed to this cause (Creuwels 2005), besides this, it is considered "vulnerable" by the IUCN (Birdlife 2000).

Ten nests were found located at the area called Cytadela (Fig. 2), presenting a general density of 0.58 nests km^{-2}. In the 1978/79 breeding season, 113 nests were recorded, all of them located at Vaureal Peak and presenting a density of 6.59 nests km^{-2}. This location was, in the last years, the only one with giant-petrels outside ASPA; in the summer of 2002/03 around 60 nests were recorded, and in 2004/05 no nest was found.

By comparing both extreme periods, a decrease by 91.15 % in the species abundance is suggested. Trievelpiece & Trievelpiece (1998) found about 150 pairs of giant petrel at the western shore of Admiralty Bay. This is probably the most harmed species throughout the whole bay. Myrcha (1993) stresses that it was eliminated at the Arctowski Station area due to human activity. In Turret Point and Penguin Island, areas close to Admiralty Bay, the population of this species remains stable (Pereira et al. 1990, Pfeiffer & Peter 2003).

The increase in tourism and research activities on Antarctica appear as potential impact on the populations of these birds. Records exist on colonies near research station that disappeared or diminished drastically (Micol & Jouventin 2001, Nel et al. 2002).

Daption capense

This species breeds in colonies on hillsides between small openings in the rocks. Eight nests were registered (Tab. 1) on Chabrier Rock Island (Fig. 2) at a density of 0.47 nests km^{-2}. Jablonski (1986) also registers three nests for the same place, with a density of 0.17 nests km^{-2}.

An interpretation relative to the population status of this species appears to be difficult. Problems of interpretation have already been noted by SCAR (1992).

Phalacrocorax atriceps

The distribution of the blue-eyed shag through Admiralty Bay is restricted to a rock known as Shag Island located at the extreme east of the bay. At low tide this rock can be connected to Cape Vaureal (Myrcha 1993).

We recorded 30 nests (Tab. 1); while in the 1978/79 breeding season, 92 nests were recorded (Jablonski 1986). The comparative analysis suggests a reduction by 67.39 % in the population in Admiralty Bay after 26 years from the first data. However, this small island, which serves as a domicile for both blue-eyed shags and chinstrap penguins, does not appear to support so many individuals as Jablonski (1986) suggested. This fact raises a doubt at the time of comparison of data seeking to establish a status for the species on the bay. A possible percentage reduction can probably be attributed to a overestimation of the population during the past period of the study (1986).

Larus dominicanus

This species breeds on several sites in the bay. A total of 144 nests were recorded (Tab. 1) for all ice free areas, establishing a general density of 8.39 nests km^{-2}. In the 1978/79 breeding season, 105 breeding pairs were recorded at a density of 6.12 nests km^{-2} (Jablonski 1986). It is possible to observe an increase of 37.14 % in the total abundance in the bay. Sander et al. (2005) claim that this alteration is not significant, although very large for some areas.

The nesting sites (Fig. 2) suffered some change in relation to the early data collected. New areas started being occupied in the breeding season of 2004/05: Dufayel Island, Harnasia Hill, Emerald Point, Stenhouse Bluff, and Cordillera Ullman, while other areas were abandoned: Point Hill, Vaureal Peak, Chabrier Rock, Cytadela, and Breccia Crag.

The general densities for the total of all visited ice-free areas was greater for the more recent period (8.39 breeding pairs km^{-2}) than for past period (6.12 breeding pairs km^{-2}). An area that deserves much attention in relation to density is Emerald Point. It is inhabited almost exclusively by Larus dominicanus.

Catharacta sp.

This group is divided into two species: *C. maccormicki* and *C. antarctica lonnbergi,* in addition to hybrid individuals. It is the most abundant flying bird in Admiralty Bay, with 338 recorded nests (Tab. 1) and at a density of 19.70 nests km^{-2}, distributed in almost all ice-free areas (Fig. 2). During the breeding season of 1978/79 (Jablonski 1986), a total of 50 nests were found occupying a density of 2.91 nests km^{-2}. Data comparison suggests an increase by 576 % in the species population.

However in accordance with Trivelpiece (1981), about 90 % of banded *C. antarctica lonnbergi* disappeared between 1977/78 and 1980/81. This hypothesis suggests that Jablonski's data could have been underestimated for the bay.

There are records of new occupation areas: Emerald Point, Crepin Point, and Stenhouse Bluff. There are areas where abandonment has begun: Chabrier Rock and Promotorio Negro Notable.

Minimal new data exists for these birds in Antarctica, with no clear evidence in relation to its recent population tendencies (Woehler & Croxall 1997).

Sterna vittata

There is a parecity of data for this species because of special difficulty in counting (Woehler & Croxall 1997). Its nests besides being very small are made of small stones that are confused with the colour of the terrain.

It breeds in colonies in several locations in the bay. Thirtyeight (Tab. 1) nests were recorded at seven ice-free areas (Fig. 2) at a density of 2.21 nests km^{-2}. In 1978/79 (Jablonski 1986) 246 nests were recorded at a density of 14.34 nests km^{-2}. It is possible that a reduction of 84.55 % occurred in the species abundance for the area under study.

There was also a reduction in the number of occupied sites for nesting in relation to previous data. The areas that have begun to be abandoned by the species are: Breccia Crag, Cytadela, Point Hill, Emerald Point, Urabnek Crag, and Hennequin Point. However, some areas have also been added as new places of occurrence: Dufayel Island, Stenhouse Bluff and Szafer Ridge.

Oceanites oceanicus and Fregetta tropica

These are birds whose nests are found in pits dug between larger boulders in stable and old hillsides. Both species nest in isolated or mixed colonies (Myrcha 1993). They are nocturnal birds, difficult to identify. These species are probably not being affected by human action in the region, since their nesting sites are located in steep areas, difficult to reach, in addition to their twilight habits.

A decrease in the amount of snow in the past few years in the region of South Shetland Islands is likely to be a positive factor for the species, which will not have its nests buried by the snow as occurred in the past, causing the death of recently hatched chicks. Their populations have not been assessed. There is only a record of two nesting sites. Jablonski (1986) indicated 242 pairs of *O. oceanicus.*

Chionis alba

This species is generally found associated with penguin colonies, principally *P. antarctica* (Myrcha 1993). Only four nests (Tab. 1) were recorded southeast of the bay in the regions of Harnasia Hill (1) and Chabrier Rock Island (3) (Fig. 2), contributing to a density of 0.23 nests km^{-2}. Jablonski (1986) recorded only three pairs on Chabrier Rock Island.

CONCLUSION

By comparing the results with the work by Jablonski (1986), it is possible to notice changes in relation to the size of bird populations, changes in the distribution of breeding areas and makeup of communities by location.

The numbers of kelp gull *(Larus dominicanus)* and the skuas (*Catharacta* sp.) suggest an increase in their breeding populations, even if it is not significant for the former (Sander et al. 2006) especially for kelp gull. The numbers for the antarctic tern *(Sterna vittata),* antarctic giant-petrel *(Macronectes giganteus),* blue-eyed shag *(Phalacrocorax atriceps)* and the chinstrap penguin *(Pygoscelis antarctica)* suggest the opposite.

Through a comparison with previous data (Jablonski 1986) it is possible to notice changes in the distribution of the species across ice-free areas in Admiralty Bay. Four new areas have been added to the current period: Dufayel Island, Harnasia Hill, Stenhouse Bluff, and Crepin Point. However, four areas have also ceased to be occupied as breeding sites: Point Hill, Breccia Crag, Urabnek Crag and Promotorio Negro Notable.

Visible causes of negative impact on the birds are: habitat destruction through human occupation by means of construction and enlargement of dwelling places, and construction of trails for traveling, as well as constant use of land transport machinery; constant use of airplanes and low-altitude flights inside Admiralty Bay; increase in scientific activity around the stations and, especially, in all ice-free areas in the bay more recently, an increase in tourism.

Many species seem to benefit from this new setting, especially in view of the greater food supply and, in particular, the greater ability to adapt to human activities. Some of them even nest near stations or places of intensive human activity. The skuas and kelp gulls in general are potential birds of prey. Through these benefits, the populations of these birds can grow and, consequently, increase the levels of predation on eggs and chicks of birds regarded as more sensitive, such as the antarctic tern, giant-petrel, imperial shag and the penguins.

Another factor that appears to exert an impact on antarctic seabirds is related to ambiental effects. Factors such as climatic changes, glacial retreat and decrease in available resources appear to exert appreciable effects.

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