

Observations on penguins in the King Haakon VII Sea, Antarctica

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Data on penguin density, species composition, group size and distribution were collected during the course of a seal census in pack ice in the King Haakon VII Sea, Antarctica, in January and February 1977. A total of 774 Adélie and 39 emperor penguins were counted within the 0,4 km wide census strips. An area of 288,17 km² of pack ice was censused and Adélie and emperor penguins occurred at densities of 2,69 and 0,14 individuals per km² respectively. Mean group size was $3,72 \pm 3,76$ ($n=183$) and $1,17 \pm 0,38$ ($n=29$) respectively. Mean pack ice concentration throughout the census was $0,48 \pm 0,25$ tenths ($n=336$). Both species were seen in all ice conditions, being more numerous in open to medium ice concentrations. Emperor penguins appeared to occur mainly on very large, smooth surfaced ice floes whereas Adélie penguins occurred more commonly on small, smooth surfaced ice floes. Most individuals of both species were moulting when these censuses were conducted.

Gegewens oor die pikkewynbevolking se digtheid, spesiesamestelling, groepgrootte en verspreiding is gedurende Januarie en Februarie 1977 versamel in die loop van 'n robsensus in pakys in die Koning Haakon VII-See, Antarktika. Altesaam 774 van Adélie- en 39 keiserpikkewyne is binne die sensusstroke van 0,4 km getel. Die sensus is oor 'n gebied van 288,17km² pakys opgeneem en die onderskeidelike digtheid van Adélie- en keiserpikkewyne was 2,69 en 0,14 stuks per km². Die gemiddelde groepgrootte was onderskeidelik $3,72 \pm 3,76$ ($n=183$) en $1,17 \pm 0,38$ ($n=29$). Die gemiddelde pakyskonsentrasie dwaarsdeur die sensus was $0,48 \pm 0,25$ tiendes ($n=336$). Albei spesies is in alle ystoestande opgemerk, met groter getalle in oop tot middelmatige yskonsentrasies. Dit lyk asof keiserpikkewyne veral op groot ysskotse met 'n gladde oppervlak voorkom, terwyl Adélie-pikkewyne meer algemeen op klein ysskotse met 'n gladde oppervlak voorkom. Met die sensusopname was die meeste van albei spesies besig om te verveer.

Introduction

During January and February 1977 observations on emperor penguins (*Aptenodytes forsteri*) and Adélie penguins (*Pygoscelis adeliae*) were recorded during the course of a seal census (Condy 1977). These observations were made primarily to determine whether leopard seal (*Hydrurga leptonyx*) density was related to penguin density during this time of the year in the study area, but use was made of the opportunity to obtain data on other aspects related to the occurrence and behaviour of the penguins.

Methods

All penguins within 200 m either side of the ship were counted as the ship travelled through the pack ice. Their number and group size, the pack ice concentration (within 100 m of the penguins), and size and surface nature of occupied ice floes were recorded. Ice floe size was recorded as falling within one of three categories (i.e. < 500 m², 500-1000 m², > 1000 m²),

and the surface nature of a floe was recorded as being either smooth or hummocked. Ice floes which were only partly hummocked presented difficulties when classifying surface structure, and only that part of the floe which was occupied was classified. Penguins tended to move about a floe if the ship passed close by, so only the surface nature of that part of the floe occupied by them when they were first seen was classified.

Observations were made from the ship's bridge 10 m above the waterline, and the limits of the 200 m census strips on either side of the ship were estimated using a sighting board similar to that described by Siniff, Cline and Erickson (1970). Ship's position was recorded every 20-40 minutes using a Redifon RSN 1 satellite navigational aid. At the end of the census voyages straight line distances travelled between positional plots were summed to give total straight line distance travelled, and this distance was multiplied by total strip width (0,4 km) to determine area censused.

When assessing ice concentration, all forms of pack ice (i.e. ice floes and brash ice) were considered to contribute to ice coverage. Concentration was recorded in tenths as was done during the seal censuses (Hall-Martin 1974, Wilson 1975, Condy 1976 and 1977).

Results

Species density and composition

An area of 288,17 km² was censused (Fig. 1), and 39 emperor penguins and 774 Adélie penguins were counted. The density per km² was 0,14 for emperor penguins and 2,69 for Adélie penguins. Emperor penguins comprised 4,8 per cent of the 813 penguins counted, and Adélie penguins 95,2 per cent of the sample. The ratio of emperor penguins to Adélie penguins was 1:19,85.

Group size

Emperor penguins were solitary except for five groups each consisting of two individuals, and mean (\pm S.D.) group size was $1,17 \pm 0,38$ individuals ($n=29$). Data on group size of Adélie penguins are given in Table 1; mean (\pm S.D.) group size was $3,72 \pm 3,76$ ($n=183$). The group size of emperor penguins seemed to be little influenced by pack ice concentration, but in the case of Adélie penguins group size was largest when pack ice concentration was 0,4 - 0,8 tenths.

Occurrence according to pack ice concentration

During the censuses, pack ice concentration within 100 m of the ship was recorded every 30 minutes, and mean (\pm S.D.) pack ice concentration was $0,48 \pm 0,25$ tenths ($n=336$). The data on pack ice concentration within 100 m of observed penguins are given in Table 2.

Occurrence according to ice floe size and surface nature

Data on the distribution of emperor and Adélie penguins according to ice floe structure are given in Table 3. The surface

Table 1

Group size of Adélie penguins in the King Haakon VII Sea, Jan/Feb 1977.

Number penguins per group	Observed frequency	% frequency	Number of penguins per group	Observed frequency	% frequency
1	43	23,5	9	2	1,1
2	47	25,7	10	1	0,5
3	28	15,3	11	1	0,5
4	21	11,5	12	1	0,5
5	12	6,6	14	1	0,5
6	10	5,5	16	2	1,1
7	5	2,7	19	2	1,1
8	5	2,7	>20	2	1,1

Total number of groups = 183

*Two groups containing >20 individuals were observed, one group of 22 and one group of 25.

Table 3

Distribution of penguins in relation to ice floe size and surface nature in the King Haakon VII Sea, Jan/Feb 1977.

Species	Ice Floe Size			Ice floe surface nature	
	<500m ²	500-1000m ²	>1000m ²	Smooth	Hummocked
emperor penguins	10	16	13	32	7
%	25,6	41,0	33,3	82,1	17,9
Adélie penguins	448	230	96	576	198
%	57,9	29,7	12,4	74,4	25,6

Table 2

The occurrence of penguins in different pack ice concentrations in the King Haakon VII Sea, Jan/Feb 1977.

Species		Pack ice concentration (in tenths)										Total number of penguins observed
		0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0	
emperor penguins	n	—	8	9	7	7	2	2	2	2	—	39
	%	0	20,6	23,2	17,9	17,9	5,1	5,1	5,1	5,1	0	100,0
Adélie penguins	n	146	102	115	123	82	41	95	60	10	—	774
	%	18,9	13,2	14,9	15,8	10,6	5,3	12,3	7,8	1,2	0	100,0
Total	n	146	110	124	130	89	43	97	62	12	—	813
	%	18,0	13,5	15,3	16,0	10,9	5,3	11,9	7,6	1,5	0	100,0

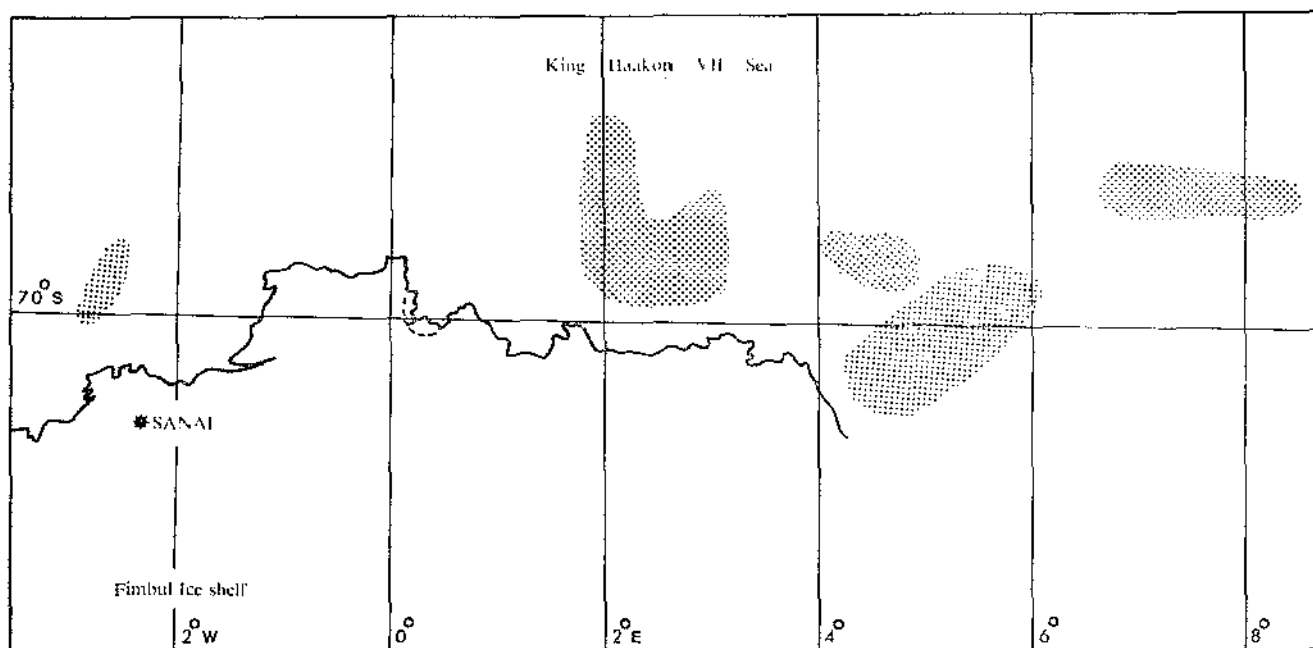


Fig. 1. Areas censused (shaded) in the King Haakon VII Sea, in Jan/Feb 1977.

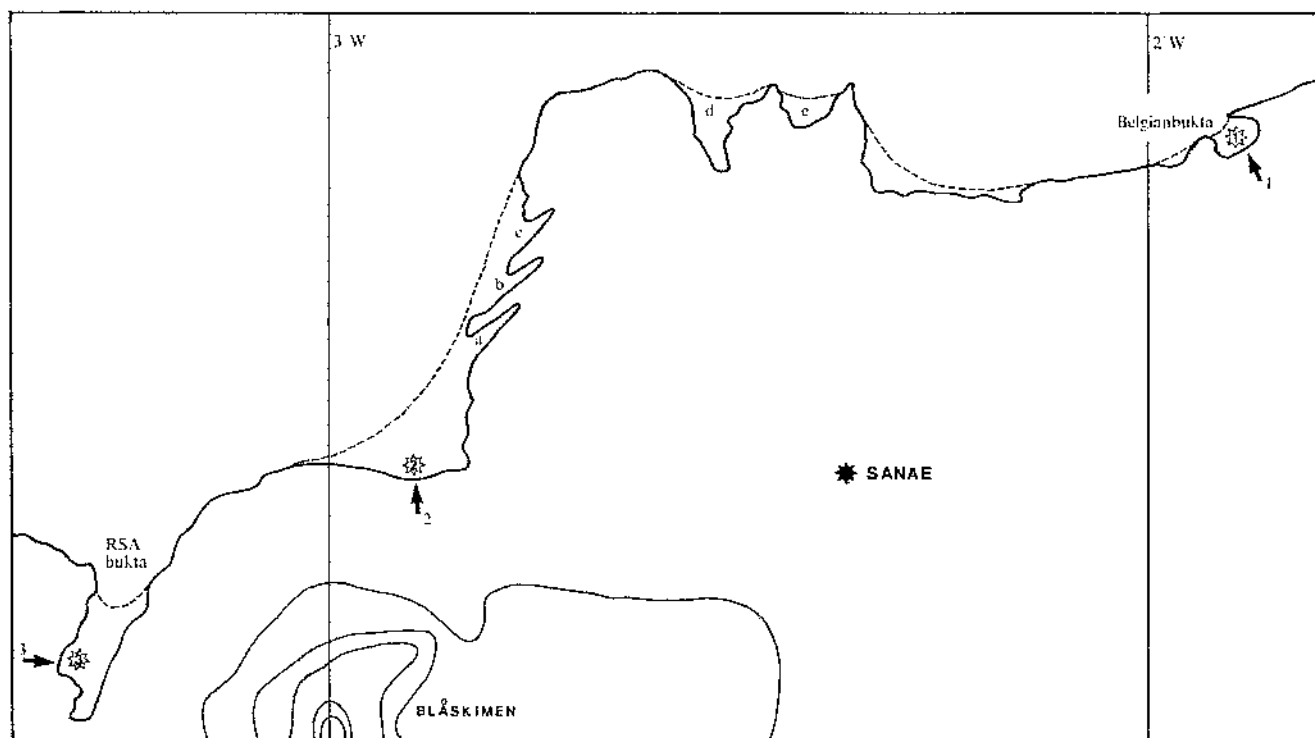


Fig. 2. Locations of emperor penguin colonies (1, 2 and 3) off the ice shelf near SANAE, in Jan/Feb 1979 (a – Polarbjornbukta; b – Polarsirkelbukta; c – Tottanbukta; d – Muskegbukta; e – Otterbukta). The Bay Ice front in Dec. 78/Jan. 79 is indicated by a broken line off parts of the coastline.

of ice floes varied from completely flat and smooth to extremely irregular and hummocked as a result of overriding and pressure ridges.

Discussion

Due to the ship's erratic course through the pack ice, the straight line distance was less than the actual distance travelled and therefore the densities of emperor and Adélie penguins calculated from these data are overestimates. Erickson, Denney, Brueggeman, Sinha, Bryden and Otis (1974) censused 173,55 km² of the pack ice in the eastern Indian Ocean off Adélie, Claire and Banzare coasts during January and February and counted 301 Adélie penguins and 53 emperor penguins, giving densities of 1,73 per km² and 0,31 per km² respectively, and a species composition of 85,0 per cent Adélie penguins and 15,0 per cent emperor penguins. It appeared that emperor penguins were slightly more numerous and Adélie penguins slightly less numerous in the pack ice of the eastern Indian Ocean than in the King Haakon VII Sea (Fig. 1).

Although a few large groups of Adélie penguins were observed (Table 1), such groups were not common and mean group size was small (3,72 individuals per group). Generally emperor penguins were solitary, sometimes associated with small groups of Adélie penguins. Many of the Adélie penguins and most emperor penguins were moulting.

Both species appeared to prefer smooth surfaced ice floes, with Adélie penguins showing a preference for smaller floes while emperor penguins seemed to prefer medium sized floes (Table 3). Adélie penguins were seen throughout the 24 hour cycle, being least numerous between 19h00 and 24h00 (GMT), which may be an important feeding period. Emperor penguins were not seen between 07h00 and 17h00 (GMT), suggesting

that surface activity occurs mainly during the polar summer 'nocturnal' period, and feeding occurs mainly during the normal daylight hours.

Leopard seals occurred at a density of 0,02 per km², only five being seen (Condy 1977). The ratio of leopard seals to emperor penguins and Adélie penguins was 1:7,8:154,8. In the eastern Indian Ocean the ratio was 1:2,7:15,1 but the density of leopard seals was 0,40 per km² (Erickson *et al.* 1974), or twenty times greater than the density in the King Haakon VII Sea. Thus there would appear to be a negative relationship between the density of leopard seals and penguins, Adélie and emperor penguins occurring in greater densities where leopard seal density is lower. However, leopard seals feed on fish, squid and krill, as well as on penguins, sea birds and young seals of the other Antarctic phocids (Laws 1964, Øritsland 1977). Øritsland (1977) indicated that krill was a substantial, if not major food of leopard seals and results obtained by Hofman, Reichle, Siniff and Müller-Schwarze (1977) showed that krill and penguins comprised 84,6 per cent and 5,1 per cent respectively in faecal samples and stomach contents of leopard seals at Palmer Station (64°46'S, 64°05'W), on the Antarctic Peninsula. These observations suggest that while some form of relationship between leopard seals and penguins may be shown to exist, the abundance of the former need not necessarily be related to the abundance of the latter, and such relationships may be incidental, depending on the occurrence of other food items eaten by leopard seals and/or penguins.

Postscript

During the period January-March 1979, three emperor penguin breeding colonies were found on bay ice near SANAE (70°19'S, 20°21'W), Queen Maud Land. In January and

February fast bay ice was considerably more extensive than had been experienced during the 1976 and 1977 seal surveys (Condy 1976 and 1977) and the areas (Fig. 2) where these colonies were found in 1979 were devoid of bay ice during the periods 23-24 January 1976 and 20-21 January 1977. All three colonies occurred close (< 1 km) to the ice shelf. Colony 1 (Belgian bukta) comprised 84 adults, of which 51 (60,7 %) were moulting and 37 were chicks in various stages of moult; Colony 2 (Blaskimen Bay) could not be visited but observation through binoculars indicated that it was approximately twice the size of Colony 1; and Colony 3 (RSA bukta) comprised 34 adults, of which 27 (79,4 %) were moulting and six were unmoulted chicks. Scattered within Colonies 1 and 3 were 11 and 14 Adélie penguins respectively (all moulting).

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A digital mosaic of Antarctic Landsat images

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In response to a request by the South African Scientific Committee for Antarctic Research, the National Physical Research Laboratory has produced by digital means a mosaic of Landsat scenes of the area 70-75°S, 6°W-3°E, to be used as a basis for maps of the region.

Na aanleiding van 'n versoek deur die Suid-Afrikaanse Wetenskaplike Komitee vir Antarktiese Navorsing, het die Nasionale Fisiese Navorsingslaboratorium d.m.v. syfer tegnieke 'n mosaïek van Landsatbeelde van die gebied 70-75°S, 6°W-3°E geproduseer, om te dien as basis vir kaarte van die gebied.

Introduction

Since 1972 earth observation satellites of the Landsat (ERTS) series have been imaging the earth's surface between 80°N and 80°S on a global scale (Malan 1974). This survey includes very useful cloud-free imagery of the Antarctic continent (Southard & MacDonald 1974). The images are distributed by the U.S. National Aeronautics and Space Administration (NASA) through the EROS Data Centre of the Department of the Interior in both photographic and digital form. Photographic images derived from the Multispectral Scanner (MSS),

have been used for the production of Antarctic maps (Colvocoresses & MacDonald 1976).

Landsat imagery in digital form on computer compatible magnetic tape lends itself to more sophisticated processing techniques than the standard photographic product and leads to a final hard copy of much higher quality. SASCAR (South African Scientific Committee for Antarctic Research) consequently requested the National Physical Research Laboratory (NPRL) to investigate the possibility of producing a mosaic of Landsat scenes of its region of interest (70-75°S, 6°W-3°E) by digital means. They intend to use the mosaic thus produced as a basis for three geological maps and other application mapping of the region at 1:250 000 scale.

Methods

Input data

Photographic copies of all the useful MSS images of the area were ordered from the EROS Data Centre catalog. Band 7 images recorded in the 0,8-1,1 μm region were selected as giving the best contrast.