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Antarctic Circumnavigation in Austral Summer 1996/97: Preliminary Results of Sea Bird and Mammal Survey

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ABSTRACT. Preliminary results of sea bird and mammal survey carried out during Antarctic circumnavigation (1996-97) are presented. We analysed broadscale spatial distribution patterns in top predators as related to marine habitats. Totally more than 40 taxa were recorded at sea. The most numerous seabirds were Adélie Penguin, Antarctic and Snow Petrels, Southern Fulmar, accounted for 66.5% of the total. The overall mean density was 8.36 birds km^{-2}, with elevated values found in marginal ice zones, coastal waters of the Antarctic Peninsula and recurring polynyas. The rest of the habitats were characterized by surprisingly similar values, about 5 birds km^{-2}. Totally 720 Cetaceans of 9 taxa were recorded. Orcas were the most numerous, while Minke Whales were the most frequent. Greatest numbers of Minke Whales were clearly confined to the shelf breaks, while Humpbacked Whales were abundant in coastal waters of the Peninsula. Most Orcas were sighted in flaw polynyas. Both, abundance and frequency of five observed Pinniped species are well in concordance with known habitat use and total population numbers. Obtained data on differences in distribution patterns among different top predator groups apparently reflect a different way of food resource utilization, although the diets are similar. Brief overview of on land observations are given.

Key Words: Antarctica, ice habitats, pelagic distribution, sea birds and mammals

Introduction

Marine top predators like sea birds and mammals draw attention as they are considered monitors of environmental changes and are potentially highly vulnerable regarding human impact. Taking into account dramatic story with whale overfishery followed by considerable re-construction of maritime Antarctic ecosystem, continuous human exploitation of krill stock and development of other human activities in Antarctica, data on distribution patterns and ecological structure of predator communities as well as on their population status are still of great importance.

The at-sea distribution of marine birds and mammals is well known to relate to physical and biological characters of the ocean environment over different scales. The most important physical feature in the Antarctic appears to be the ice cover. The seabird pelagic 'communities' were found to be strongly influenced by the type and amount of sea ice present (Fraser and Ainley 1986; Hunt 1991a; Joiris 1991; Veit and Hunt 1991). Association between seabird aggregations and some oceanological features like ice edge or shelf break has been found, but discrepancies in the results are often observed (Ainley and Jacobs 1981; see Hunt 1991a, c for review).

During austral summer 1996/97 the author was fortunate to participate in Antarctic circumnavigation aboard the ice-breaker 'Kapitan Khlebnikov'. This lengthy cruise provides information on wider longitudinal extent than is usually available from the survey during a single year.

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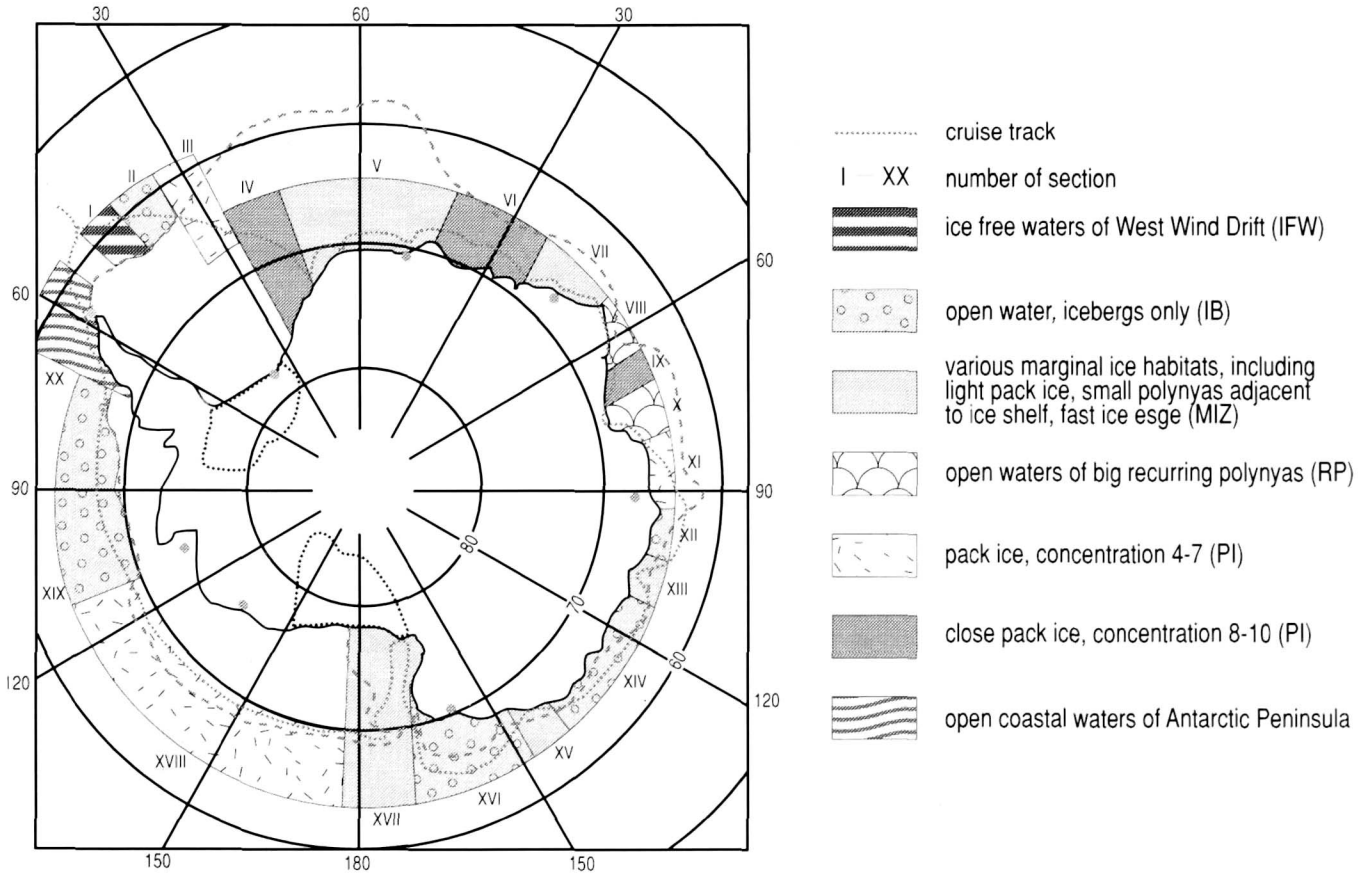

Fig. 1. Study area.

Methods and Study Area

When moving at sea, observations on seabirds, seals and whales were carried out from the pilot bridge (20 m above sea level). Strip transect method (BIOMASS 1984) was used for birds. Ship-followers were recorded when first appeared within the counting area, and omitted afterwards. Birds as well as seals were counted by a single observer in a band transect (usually of 300 m width, the view angle 90°) in time blocks of 10 minutes. For seals and cetaceans, line transect method was used simultaneously. The data presented here are based on recorded animal numbers, no correction factors (for diurnal changes in haul-out behaviour of Crabeater Seals, detectability of different whale groups or bird concentrations on icebergs outside transect) have not yet been applied. The coordinates of the ship, motion speed and direction were taken from the GPS every 10 minutes. Weather conditions and physical features were also recorded in each interval. Additionally to the quantitative counts, qualitative data were obtained on the occurrence of bird aggregations outside transect limits.

Observations were started on November 25, 1996 in the Scotia Sea and finished on January 24, 1997 in the Drake Passage. The duration of quantitative counts totalled 270 hours, being spread more or less evenly through the route to get representative coverage of different regions. Daily duration of counts was 6-8 hours on average (except days of landings) in 2 or 3 attempts. For whales all records en-route during the entire cruise were possible to obtain due to a valuable help of the crew and the passengers.

Here we present preliminary results and brief analysis of broadscale spatial distribution patterns in birds, seals and whales as related to some oceanographic factors, ice conditions and geographical regions. The ship was travelling around the Antarctic continent eastward keeping mostly to the East Wind Drift. We have divided the survey area into 20 sections depending on prevailing habitats (Fig. 1) and consider here distribution over these major units.

This was a tourist cruise and periods of sailing

were punctuated by numerous visits ashore. While landing all bird and mammal species were recorded, quantitative counts or number estimating were conducted when time and conditions allowed.

Results and Discussion

Pelagic survey

Totally 1,690 quantitative ten-minute counts were carried out during the cruise, giving a total strip transect coverage of 1,806 km^2 (Table 1). More than 40 taxa were recorded at sea with seabirds constituting two thirds.

The most numerous seabird species occurred to be Adélie Penguin (*Pygoscelis adeliae*), Southern Fulmar (*Fulmarus glacioloides*), Antarctic Petrel (*Thalassoica antarctica*) and Snow Petrel (*Pagodroma nivea*), accounted for 66.5% of the total (Table 1). The latter two species were also the most widespread throughout entire area covered. The less diverse avian communities were tied up with close pack ice (Fig. 2). Five species including Emperor (*Aptenodytes forsteri*) and Adélie Penguins, Snow and Antarctic Petrels, Arctic Tern (*Sterna paradisea*) were dominant, Southern Polar Skua (*Catharacta maccormicki*) and Southern Giant Petrel (*Macronectes giganteus*) occurred only in small numbers. Other sea-ice filled habitats were characterized by uniform assemblages of 8-9 Antarctic breeding species. Marine habitats, free of sea-ice, were represented in our survey mostly by bergy waters (IB) within outer portion of Eastern Wind Drift and Antarctic Divergency. Light-mantled Sooty Albatross (*Phoebetria palpebrata*) and Antarctic Prion (*Pachyptila desolata*) were marking species for this habitat. Bird assemblages consisting of 10-12 species showed some longitudinal variability. Mottled Petrel (*Pterodroma inexpectata*) and Soft-plumaged Petrel (*Pterodroma lessonii*) were found in the sector off Australia and New Zealand only, while White-chinned Petrel (*Procellaria aequinoctialis*) was observed in small numbers in the area south of Drake Passage. The highest species variety was recorded in coastal waters of Antarctic Peninsula and within a short transect along the West Wind Drift in the Scotia Sea, reaching 18 and 13 species, respectively. Addition of inshore foraging birds to the typical pelagic species accounted for such a diverse seabird mixture in waters washing Antarctic Peninsula.

Table 1. List of seabirds observed during Antarctic Circumnavigation, 1996/97. Number/Percent, Total number/percent of individuals recorded in transect band; Frequency, Number of quantitative counts during which species was recorded (total number of counts is 1,690)

Species	Number	Percent	Frequency
Aptenodytes forsteri	284	2.2	141
Pygoscelis papua	151	1.2	12
Pygoscelis adeliae	3,671	29.0	271
Pygoscelis antarctica	383	3.0	16
Pygoscelis sp.	634	4.8	31
Diomeda exulance	7	0.05	6
Diomeda melanophris	61	0.5	46
Diomeda chrysostoma	9	0.07	9
Phoebetria palbebrata	38	0.3	32
Macronectes giganteus	87	0.7	76
Macronectes hallii	1	0.01	1
Fulmarus glacioloides	1,652	13.0	273
Daption capense	853	6.7	144
Thalassoica antarctica	1,566	12.3	308
Pagodroma nivea	1,513	11.9	479
Pterodroma inexpectata	234	1.8	117
Pterodroma mollis	6	0.05	6
Chalobaena caerulea	8	0.06	3
Pachiptila spp.	343	2.7	99
Procellaria aequinoctialis	13	0.1	13
Puffinus sp. (*griseus*?)	5	0.04	5
Oceanites oceanicus	504	4.0	181
Fregetta tropica	159	1.3	46
Phalacracorax atriceps	9	0.07	9
Catharacta spp.	101	0.8	53
Larus dominicanus	18	0.1	4
Sterna paradisea	328	2.6	32
Sterna vittata	32	0.3	15

Our observations support an opinion about the uniform composition of seabird pelagic 'communities' over entire Antarctic zone of the Southern Ocean (Hunt 1991b; Veit and Hunt 1991). The data obtained for the past twenty years revealed three aboriginal bird species of the Antarctic continent to be dominating consistently within this zone. They

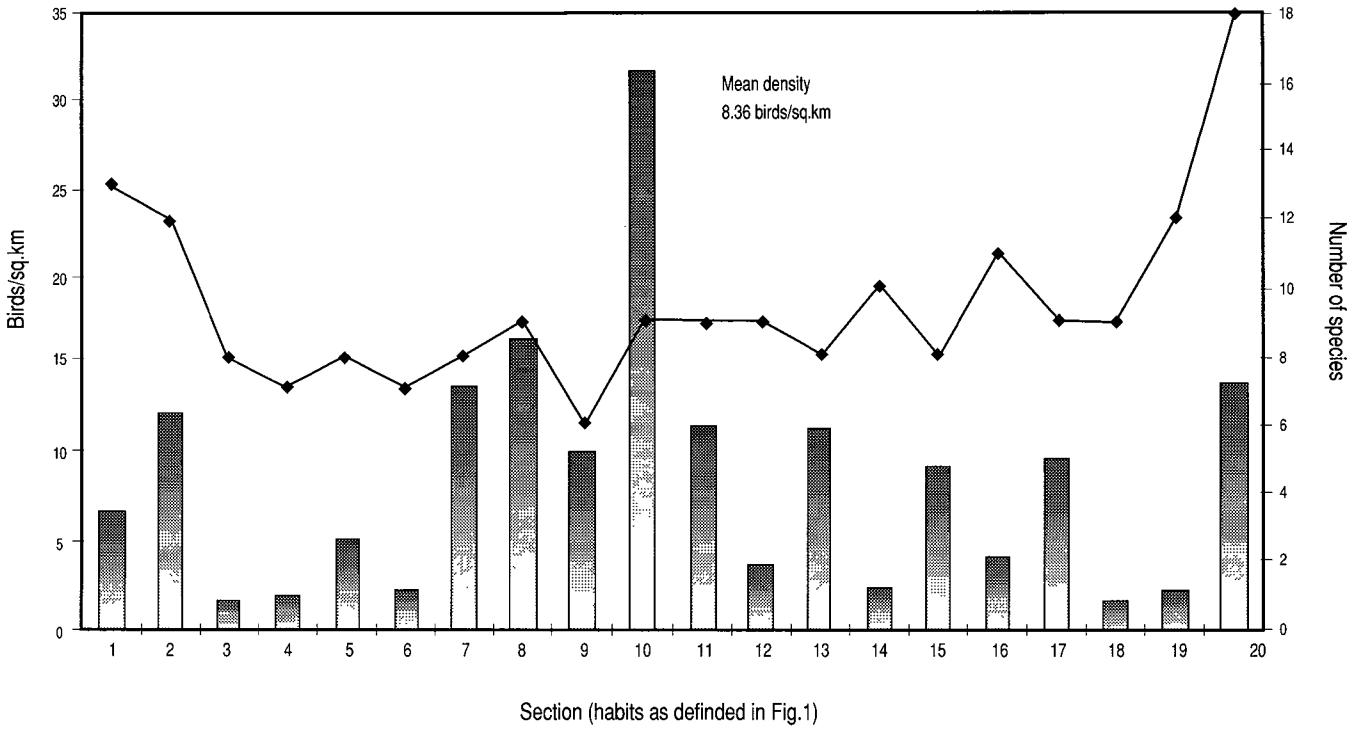

Fig. 2. Overall seabird density and number of species over different sections.

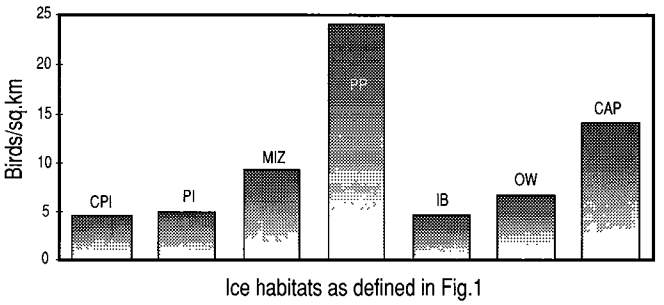

Fig. 3. Habitat use by seabirds (abbreviations as in Fig.1).

are as follows: Adelie Penguin, Antarctic and Snow Petrels (Zink 1981; Ainley *et al.* 1984, 1988; Montague 1988; Veit and Hunt 1991; our data). Their dominance does not depend on the geographical location within the zone, differences in ice conditions or time of the survey, as it is found for other dominants determined in papers listed above. For example, we saw more Antarctic Fulmars, but less Arctic Terns (*Sterna paradisea*) and almost no Shearwaters (*Puffinus* sp.) than Veit & Hunt (1991) during their circumnavigation, probably because we worked too early in the season for Arctic Terns, and kept too far south for Shearwaters.

The overall mean density in our survey was 8.33 birds km^{-2}. Elevated densities were found in three habitats as follows MIZ, CAP and RP (Fig. 3, for abbreviations see Fig. 1), with value in the latter being 3.5 times higher than overall average. The rest of the habitats characterized by surprisingly similar values, about 5 birds km^{-2}. We did not see any large seabird aggregations during our cruise as Veit & Hunt (1991) had observed. Two numerous feeding flocks were found in the sector between 60° and 80° E. A loose flock guesstimated at several thousands of Southern Fulmars accompanied by much fewer numbers of Antarctic Petrels was recorded off Mawson Land on December 17. Another feeding flock numbered several hundring of Southern Fulmars and Wilson's Storm Petrels (*Oceanites oceanicus*) was sighted in north-eastern Prydz Bay on December 23. Both aggregations were found in shelf open waters of recurring polynyas (as defined in Romanov 1996). We did not find any elevation in bird density north of the drifting ice edge, but on the other hand, all of these habitats were characterized by the lowest overall densities. The only exception was observed in the northern Weddell Sea, where elevated bird abundance was likely associated with frontal zones adjacent to the South Orkney Islands. In the Arctic, polynyas are well proven to

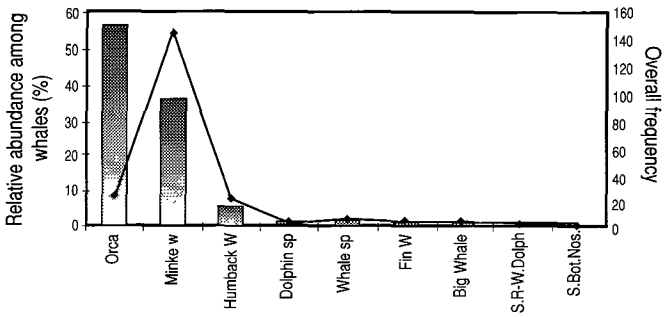

Fig. 4. Relative abundance and frequency of Cetaceans.

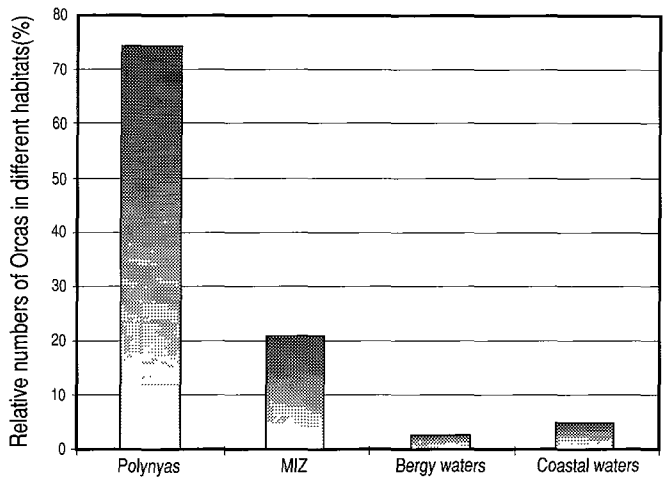

Fig. 5. Habitat use by Orcas.

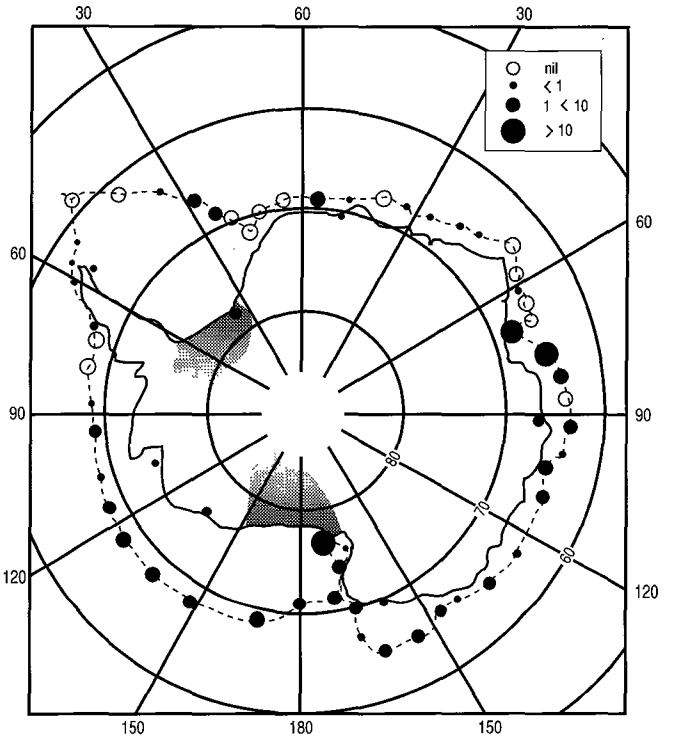

Fig. 6. Distribution of Minke Whales (relative numbers of whales sighted during 100 km of daily travel).

be of great importance for seabirds, especially during migration and breeding, but not extensive use of this habitat is found in the Antarctic (see Hunt 1991a for review). We assume the same reasons for the intense biological activity in the recurring polynyas as they are suggested for the outer zone of the retreating ice edge (Fraser and Ainley 1986). Probably we surveyed the outer marginal ice zone too early in the season to find developed zooplankton community, while in waters of recurring polynyas the biological season was already at a more advanced stage.

Totally 720 Cetaceans of 9 taxa were recorded. Orcas (*Orcinus orca*) were the most numerous, while Minke Whales (*Balaenoptera acutorostrata*) were the most frequent (Fig. 4). Orcas were sighted mostly as a single pod, but larger aggregations numbering up to 7 family groups were recorded as well. Orcas clearly preferred marginal ice habitats, and overwhelming majority were observed in shore and flaw polynyas (Fig. 5). Thus, on December 13, we saw about 120 Orcas hunting in narrow flaw polynya off Prince Olaf Coast. Minke Whales were widespread over the entire route travelled. The highest abundance was recorded in the Prydz Bay area and the Ross Sea where groups of 5-11 animals could be observed (Fig. 6). These shelf areas are known to support stable aggregations of krill (Parfenovich 1982). High probability of Minke's sightings was characteristic for the Pacific sector of the Southern Ocean. Here, the whales were not as numerous but occurred regularly. We suggest bottom risings including insular slopes and numerous banks off the Amundsen and Somov Seas, which we passed in this area, to be the habitats providing conditions for krill concentration and, hence, giving a good opportunity for whales to forage.

All but one records of Humpback Whales were restricted to the highly productive coastal waters of the Antarctic Peninsula. The whales occurred as a single animal or in small groups of 2-4 individuals.

All five Pinnipeds inhabiting Antarctic were observed during our survey. Both, abundance and frequency, were well in concordance with known habitat use and total population numbers of the species (Fig. 7). Abundance of Crabeater Seals

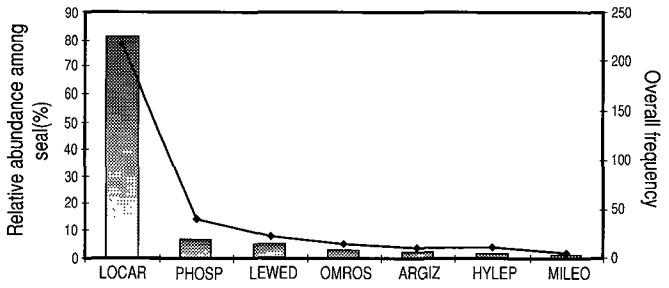

Fig. 7. Relative abundance and frequency of seals.

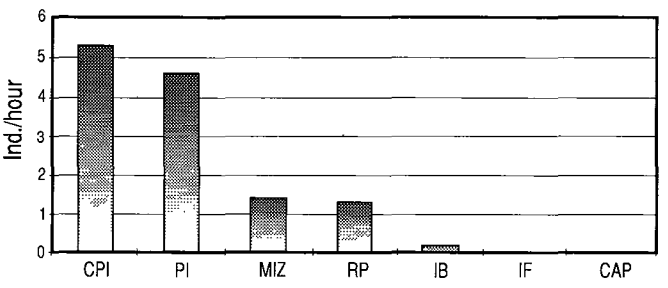

Fig. 8. Habitat use by Crabeater Seals.

Table 2. Numbers of breeding birds at selected sites. For penguins, the count accuracy is mentioned in brackets, as it used in Woehler (1991)

No	Location	Date	Species	Number	Comments
Site 2	Riiser Larsen Ice Shelf	Dec. 2, 1996	Emperor Penguin	6,000 (C3)	
Site 3	Riiser Larsen Ice Shelf, 2 70.31S/8.43W	Dec. 4, 1996	Emperor Penguin	1,600 (C2)	was not described previously
Site 4	Atka Bay	Dec. 4, 1996	Emperor Penguin	10,500 (C3)	
Site 11	Kloa Point	Dec. 16, 1996	Emperor Penguin South-polar Skua	2,625 (C1) 3 nests	
Site 13	Murray Monolith	Dec. 17, 1996	Macaroni Penguin		a dead bird
Site 32	Peterman Island	Jan. 21, 1997	Blue-eyed Shag	28 nests	
Site 38	King George Island, Turret Point	Jan. 23, 1997	Blue-eyed Shag	32 pairs+2 empty nests	

(*Lobodon carcinophagus*) appeared to be a function of the amount of ice present (Fig. 8). Here we should note that a group of at least 60 Crabeaters was recorded on light pack ice off the Amundsen Sea. Animals seemed to be forced to aggregate because of little ice available to haul out.

The distribution and abundance of predators usually reflect the availability of prey in the marine ecosystems on which they depend. Krill, the key prey in the maritime Antarctic, is found to form aggregations under conditions of current perturbation - in the zones of secondary fronts, mainly within the high latitudinal waters (Makarov and Spiridonov 1993). Physical structures responsible for maintaining stable aggregations include continental and insular slopes, bottom risings and banks, pack ice edge, fronts between high-latitudinal waters and waters of West Wind Drift along the northern boundaries of larger gyres (Parfenovich 1982). The predators may be expected to aggregate in such habitats, given the prey is accessible to them.

Our data reveal a number of areas characterized by elevated numbers of different top predator groups as follows:

- Shelf waters of Prydz Bay, Ross Sea and Bransfield Strait (sections X, XVII, XX) - high abundance of both birds and whales;
- Pacific sector, 120-180 W (section XVIII) - high abundance of both whales and seals;
- Area off the Coast of Princess Ranghill (section VI) - high abundance of seals.

Such distribution patterns suggest prey, even being abundant, may be accessible not for all consumers. The differences in distribution patterns among different top predator groups apparently reflect a different way of food resource utilization, although the diets are similar. For example, abundant Minkes and Crabeaters in pack ice in open ocean of section XVIII coupling with very low bird density suggest prey to aggregate at a certain depth, hence being inaccessible for surface feeding Tubenoses, and for pursuit diving penguins as well, because of coast remoteness. Ice conditions are also well shown to affect prey accessibility for birds. Heavy ice conditions found in section VI apparently account for the only one predator, Crabeater Seal,

was observed there in high numbers, whilst seabirds and whales avoided this area. Interesting, that Orcas occurred in greatest numbers in the same ice habitats as seabirds did, but only once a flock of petrels was seen feeding among the foraging dolphins. Further analysis will be focused on the ecological structure of top predator pelagic communities and habitat selection in different species.

At shore observations

Totally we visited 39 sites. Here we present some highlights of our observations at landing sites (Table 2). Those Emperor Penguin rookeries are included where total counts were conducted. Dramatic changes in the population trend of the Blue-eyed Shag (*Phalacrocorax atriceps*) have been identified in the last SCAR review on the status of the Antarctic seabirds (Woehler and Croxall 1996). We assume our data on Shag numbers will be valuable.

Given that Antarctic tourist activity is in progress, whilst scientific programs often go down because of money shortage, the possibility of co-operation between the tourist and scientific programs looks attractive. Modern means of conveyance used by tourist operators for visiting inaccessible regions, long term planning and regular repeating of the same routes fit to the purposes of environmental monitoring studies.

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