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Results of the Biological Investigations in the Weddell Sea during a Site Survey 1979/80

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Summary: Biological investigations during the cruise of M/V POLARSIRKEL were part of the scientific programmme accompanying the pre-site survey. On 125 biological stations, 272 hauls on plankton and fish were carried out. 24 fish species had been determined, most of them had previously not been found in the Weddell Sea. The investigations also comprised a count of birds and seals. The fate of fluorine in the food chain and cadmium analyses were subject of the biochemical investigations.

Zusammenfassung: Biologische Untersuchungen während der Standorterkundung mit MS POLARSIRKEL bildeten einen Teil des begleitenden wissenschaftlichen Programms. Auf 125 biologischen Stationen wurden 272 Plankton- und Fischfänge durchgeführt. 24 Fischarten konnten bestimmt werden, von denen nur wenige bisher in der Weddell-See gefangen wurden. Zu den Untersuchungen gehörte ebenfalls die Zählung von Vögeln und Robben. Biochemische Untersuchungen galten dem Schicksal des Fluors in der Nahrungskette und dem Cadmiumgehalt in einigen antarktischen Tieren.

INTRODUCTION

The biological programme during the pre-site survey comprised mainly marine biological investigations: studies of zooplankton and micronekton on the whole cruise and especially in the Weddell Sea as well as investigations on the distribution of fish in the Weddell Sea. A survey of birds and seals was also carried out.

The problem of the high fluoride values in krill caused us to take samples of other Euphausiids and of krill-feeding animals for fluoride analyses, in order to get an impression of whether the high fluoride content in krill is maintained in the next link of the food chain. The same samples were used for heavy metal and PCB analyses.

MATERIAL AND METHODS

The standard net used for oblique hauls during the whole cruise was a Bongo net (∅ 61 cm). Vertical hauls with a Nansen closing net (∅ 70 cm) were carried out for the collection of krill larvae from different depths. Altogether 272 hauls were made on the way from South Georgia to the ice shelf barrier at Cape Norwegia, along the barrier, in a ,,box'' (40 x 40 nautical miles) at the barrier in the southern Weddell Sea and on the way from the barrier to Bouvet Island (see Figs. 1, 2). Benthos and fish were caught by a beam trawl (3 x 1 m) and a modified Agassiz trawl (1,5 x 1 m) mainly in the ,,box'' but also on the way to the Antarctic Peninsula (see Fig. 3).

Counting of birds was mainly carried out on the upper deck during the plankton or benthos sampling; counting of seals and penguins was effected from a helicopter, from the ship, or on skis. A crab-eater seal (*Lobodon carcinophagus*) and two Adélie penguins (*Pygoscelis adéliae*) were killed and sectioned. The age of the seal was determined as 5+ years. The different tissues were frozen and stored for fluoride, heavy metal, and PCB tests; the same was done with different krill and fish species.

Cadmium analyses were carried out by use of a BECKMANN atomic absorption spectrophotometer (AAS) model 1348.

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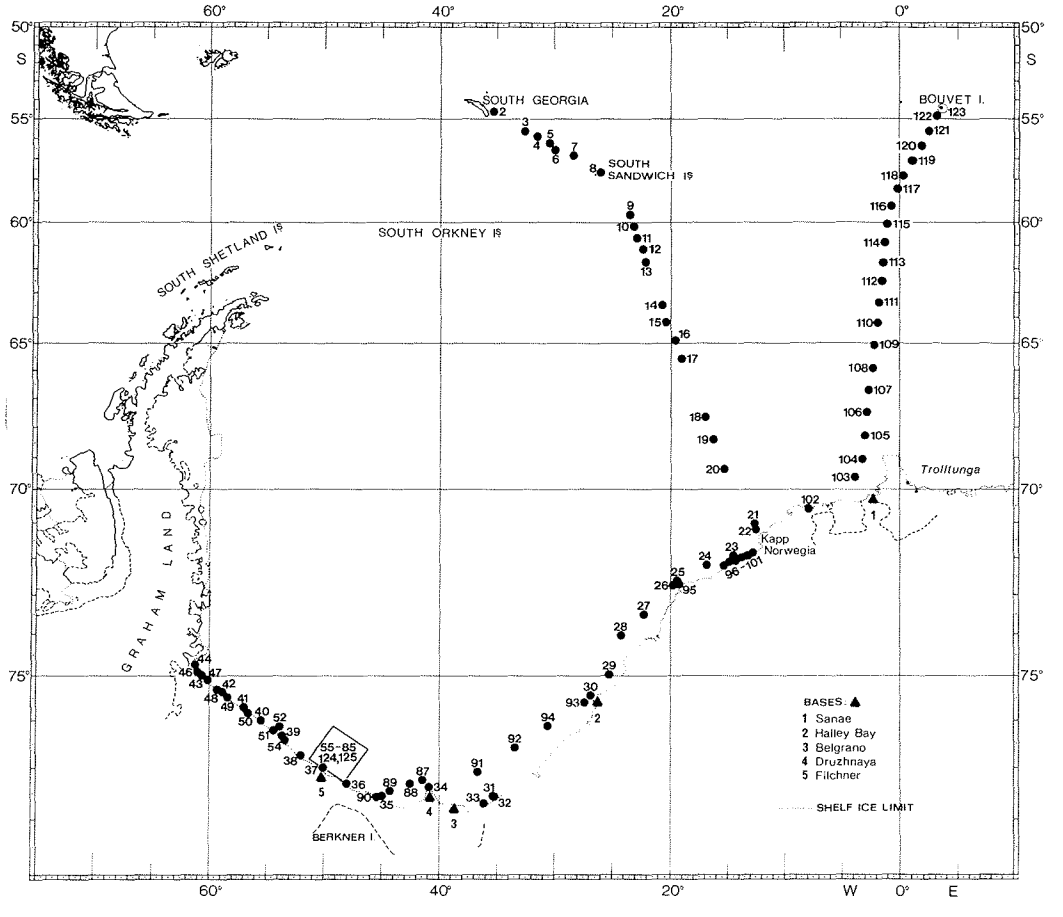

Fig. 1: Marine biological stations (plankton) during the 1979/80 cruise of M/V POLARSIRKEL.

Abb. 1: Marin-biologische Stationen (Plankton) während der Reise mit MS POLARSIRKEL 1979/80.

RESULTS AND DISCUSSION

Plankton

Evaluation of the plankton samples could not be finished yet and will be published elsewhere.

Fish

Tab. 1 shows the list of fish species found in the catches; most of these species had previously not been found in the Weddell Sea. Dominant in the catches were the species *Prionodraco evansii* and *Trematomus eulepidotus* (see Fig. 4). Although only one specimen of *Trematomus hansoni* was caught, this nevertheless implies a wide distribution in the Antarctic: Besides its known occurrence in the ,,warm'' waters of the Antarctic, e. g. around South Georgia, it also lives in the extremly cold waters at the ice shelf barrier of the Weddell Sea. The well-developed resistance to freezing found in this species from South Georgia already indicated good adaption also to temperatures near the freezing-point of sea-water (SCHNEPPENHEIM & THEEDE, 1979). 7 specimens of *Pagetopsis maculatus*, only once described by BARSUKOV & PERMITIN (1958) from one specimen, were caught in the ''box''. 2 specimens of the ge-

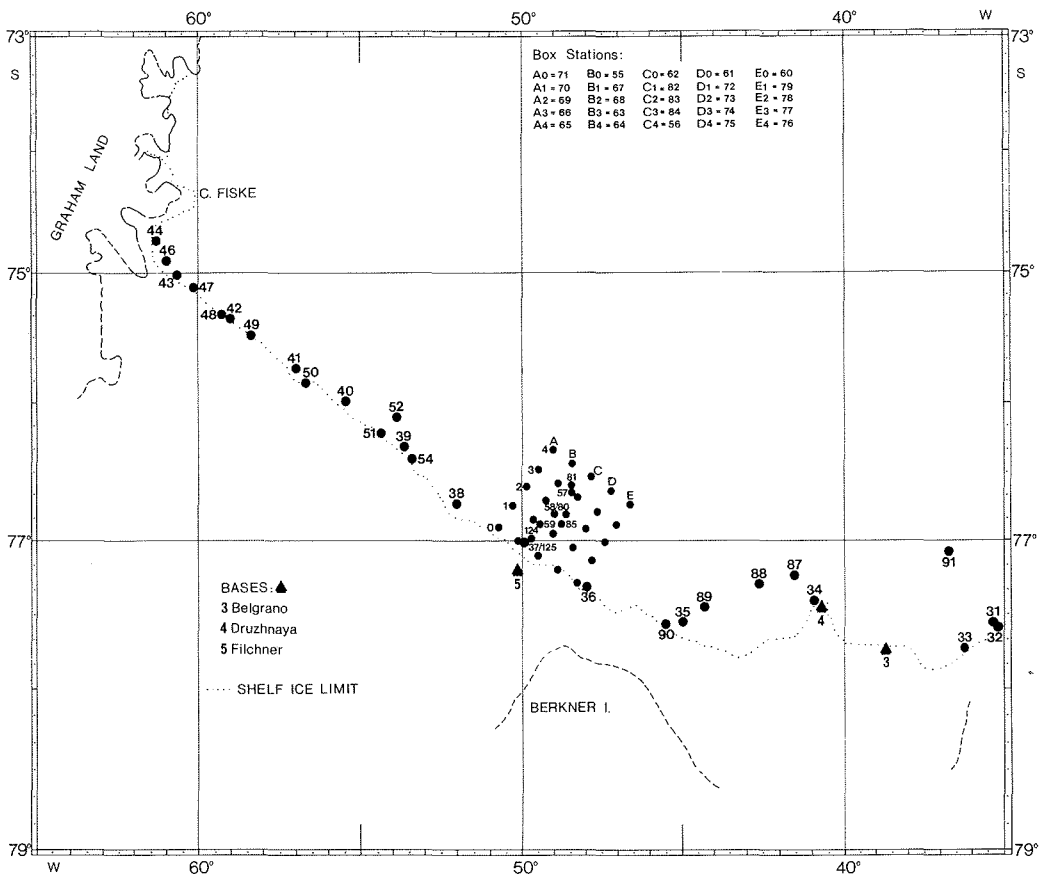

Fig. 2: Marine biological stations (plankton) in the southern Weddell Sea during the 1979/80 cruise of M/V POLARSIRKEL.

Abb. 2: Marin-biologische Stationen in der südlichen Weddell-See.

nus Bathydraco were caught near the Antarctic Peninsula, in a region normally covered with ice throughout the year. The species could not be determined and is possibly a new one.

All the catches were only possible because of the excellent ice conditions in that season. A report on the distribution and the biology of the fish caught on this cruise is in preparation and will be published elsewhere.

Benthos

The benthos material was given to the Instituto Antarctico Argentino in Buenos Aires. Results are not yet available.

Birds

As expected, the number of species is very low in this extreme part of the Weddell Sea. The only species found on the Antarctic Peninsula off Nantucket Inlet are *Pagadroma nivea* and *Talassoica antarctica*. Tab. 2 shows the list of counted birds based on a 10-minute count in a radius of about 200 metres around the ship at several marine biological stations.

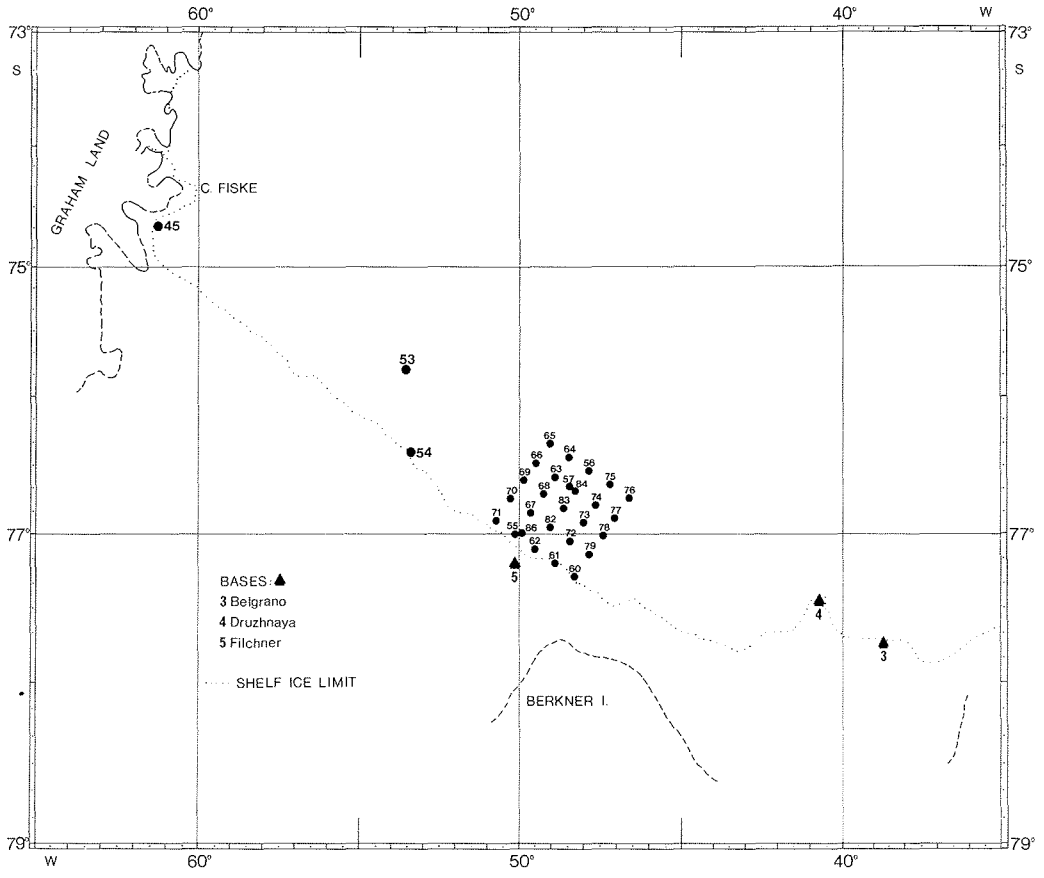

Fig. 3: Marine biological stations (fish and benthos) in the southern Weddell Sea during the 1979/80 cruise of M/V POLARSIRKEL.

Abb. 3: Marin-biologische Stationen (Fisch und Benthos) in der südlichen Weddell-See.

Seals and colonies of penguins

Attempts were made to count seals and penguins from a helicopter, from the ship under way and on skis. Because of cracks and ridges in the ice, where seals are quite often hidden, only the survey by helicopter is a reliable method. One problem in the pack ice is the estimation of the size of the area surveyed; the helicopter needs navigation equipment enabling the pilot to maintain a true course and to know the exact speed independent of the wind speed. Tab. 3 shows the result of the survey; in Fig. 5 a typical distribution of seals and penguins in an inlet is shown.

A particularly interesting observation was made of an Adélie penguin coming over the ice shelf from the direction of the continent. Following its tracks in the opposite direction, I found a constant course of 235° over a distance of 25 km without reaching the end of the tracks. In this direction only ice is to be found for more than 300 km.

Fluoride and cadmium analyses

Fluoride analyses of krill-feeding animals and different Euphausiid species showed very interesting results. In all Euphausiids the fluoride concentrations are high, however, *Euphausia crystallorophias* has

Family Nototheniidae	**Station and no. of animals**
Genus Trematomus	
Trematomus eulepidotus REGAN, 1914	54(1), 55(47), 56(6), 57(1), 63(3), 65(2), 69(2), 71(41), 77(2), 82(2)
T. scotti (BOULENGER, 1907)	55(1), 56(1), 63(1), 64(1), 65(2), 67(1), 71(1), 76(1), 77(1), 83(1)
T. bernacchii BOULENGER, 1902	55(3), 71(1)
T. borchgrevinki BOULENGER, 1902	61(1)
T. newnesi BOULENGER, 1902	70(1), 71(1)
T. hansoni BOULENGER, 1902	71(1)
T. loennbergii REGAN, 1913	53(1), 54(2), 56(1)
T. lepidorhinus (PAPPENHEIM, 1911)	55(1)
Genus Pleuragramma	
Pleuragramma antarcticum BOULENGER, 1902	63(1), 65(1), 68(1), 73(1), 75(2), 97(1), 99(1)
Family Harpagiferidae	
Genus Artedidraco	
Artedidraco orianae REGAN, 1914	57(1)
A. skottsbergi LOENNBERG, 1905	55(1)
A. loennbergi ROULE, 1913	71(1)
Genus Dolloidraco	
Dolloidraco longedorsalis ROULE, 1913	55(1), 69(1)
Genus Pogonophryne	
Pogonophryne marmoratus NORMAN, 1938	54(4), 57(4), 61(1), 65(1)
Family Bathydraconidae	
Genus Bathydraco	
Bathydraco spec. possibly a new species	53(2)
Genus Gerlachea	
Gerlachea australis DOLLO, 1900	53(1), 54(2), 57(3), 66(1), 75(2), 76(2), 84(1)
Genus Racovitzia	
Racovitzia glacialis DOLLO, 1900	53(1), 54(1), 57(2), 75(1)
Genus Prionodraco	
Prionodraco evansii REGAN, 1914	55(43), 57(18), 63(1), 66(1), 69(1), 73(78), 74(13), 75(3), 76(1), 77(1), 78(2), 84(3)
Genus Cygnodraco	
Cygnodraco mawsoni WAITE, 1916	55(8), 56(2), 61(1), 63(1), 65(1), 69(3), 71(1), 76(1)
Genus Gymnodraco	
Gymnodraco acuticeps BOULENGER, 1902	55(1)
Family Channichthyidae	
Genus Pagetopsis	
Pagetopsis macropterus (BOULENGER, 1907)	55(3)
Pagetopsis maculatus BARSUKOV & PERMITIN, 1958	63(1), 69(1), 71(1), 74(1), 76(2), 78(1)
Genus Cryodraco	
Cryodraco antarcticus DOLLO, 1900	54(1), 69(1)
Genus Chaenodraco	
Chaenodraco wilsoni REGAN, 1914	69(1), 78(1)

Tab. 1: List of fish species from the southern Weddell Sea.

Tab. 1: Artenliste der in der südlichen Weddell-See gefangenen Fische.

values of about 50% of those of *E. superba*. As an expression of the high fluoride concentration in their food, krill-feeding animals (crab-eater, Adélie penguin, and Antartic fish) show increased fluoride values in their bones; they show higher tolerance against fluoride than man does. But they must also possess a mechanism for eliminating the high fluoride contents in their food. The results of the fluoride experiments are published in detail elsewhere (SCHNEPPENHEIM, 1980).

The cadmium concentrations of different tissues from several krill species, the decapode crustacean *Notocrangon antarcticus*, and the warm-blooded animals crab-eater and Adélie penguin are listed in Tab. 4. Higher values, with respect to the other organs, are only found in the liver and the kidneys of the penguin, and in the kidneys of the crab-eater; this is quite a usual distribution. A comparison with values obtained from seals of the North Sea (liver up to 200 ppb, kidney up to 380 ppb wet weight) by DRESCHER et al. (1977), taking into account that the values of the antarctic animals are given in dry weight, shows a

Station	Position	Ice conditions	No. and species
33	77°46' S 36°12' W	pack ice 2/8	8 *Talassoica antarctica*
46	74°39' S 61°15' W	pack ice 5/8	8 *Talassoica antarctica* 2 *Pagadroma nivea*
47	75°06' S 60°10' W	at the shelf ice barrier (700 m) pancake ice	16 *Talassoica antarctica*
53	75°47' S 53°33' W	—	2 *Pagadroma nivea*
55	77°00' S 50°00' W	on the shelf ice (8 m high)	2 *Pygoscelis adéliae*
60	77°17' S 48°17' W	at the sea ice limit	1 *Pagadroma nivea* 1 *Talassoica antarctica* 42 *Aptenodytes forsteri* 7 *Pygoscelis adéliae* 5 *Catharacta maccormicki*
61	77°10' S 49°01' W	at the sea ice/ shelf ice limit	1 *Catharacta maccormicki* 2 *Pygoscelis adéliae*
63	76°34' S 48°39' W	—	1 *Talassoica antarctica*
66	76°28' S 49°31' W	—	6 *Talassoica antarctica*
84	76°42' S 48°12' W	pack ice 2/8	1 *Pagadroma nivea*
87	77°14' S 41°34' W	—	3 *Talassoica antarctica*
96	72°13' S 15°23' W	pack ice 4/8	6 *Pagadroma nivea* 2 *Talassoica antarctica* (associated with 15 *Orcinus orca)*

Tab. 2: Birds in the southern Weddell Sea. The count ist based on a 10-min. check from the upper deck of M/V POLARSIRKEL on the marine biological stations within a radius of 200 metres.

Tab. 2: Zählung von Vögeln in der südlichen Weddell-See. Grundlage der Zählung ist eine 10-Minuten-Beobachtung auf dem Peildeck des MS POLARSIRKEL in einem Umkreis von ca. 200 m während marin-biologischer Fänge.

Date	Position	Time (GMT)	Method	Area (km²)	Species	No. of animals	Conditions
4. 1. 80	77°44'S 43°46'W	15:00	steaming ship	13,5	C S W S U. I. S. E P A P	71 23 110 2 1	multi-year sea ice of the Gould Bay
18. 1. 80	77°17'S 48°17'W	20:30	helicopter	45	C S W S U. I. S. E P A P	6 103 69 15 3	multi-year sea ice with ridges
18. 1. 80	77°17'S 48°17'W	21:00	helicopter	10	U. I. S. probably CS	20	pack ice
24. 1. 80	77°00'S 50°06'W	17:00	helicopter	11,25	C S W S	18 53	pack ice in front of the barrier
17. 2. 80	70°47'S 09°36'W	22:30	skis	12	C S W S E P A P	36 186 52 1230	sea ice of an inlet with cracks and ridges
18. 2. 80	70°47'S 09°36'W	14:30	helicopter	18	C S W S L S E P A P	48 351 2 69 1865	sea ice of an inlet with cracks and ridges

Tab. 3: Counting of seals and penguins. C S = Crab-eater seal, W S = Weddell seal, L S = Leopard seal, U. I. S = unidentified seal, E P = Emperor penguin, A P = Adélie penguin

Tab. 3: Zählung von Robben und Pinguinen. CS = Krabbenfresser-Robbe, WS = Weddel-Robbe, LS = Leoparden-Robbe, UIS = nicht identifizierte Robbe, EP = Kaiser-Pinguin, AP — Adélie-Pinguin.

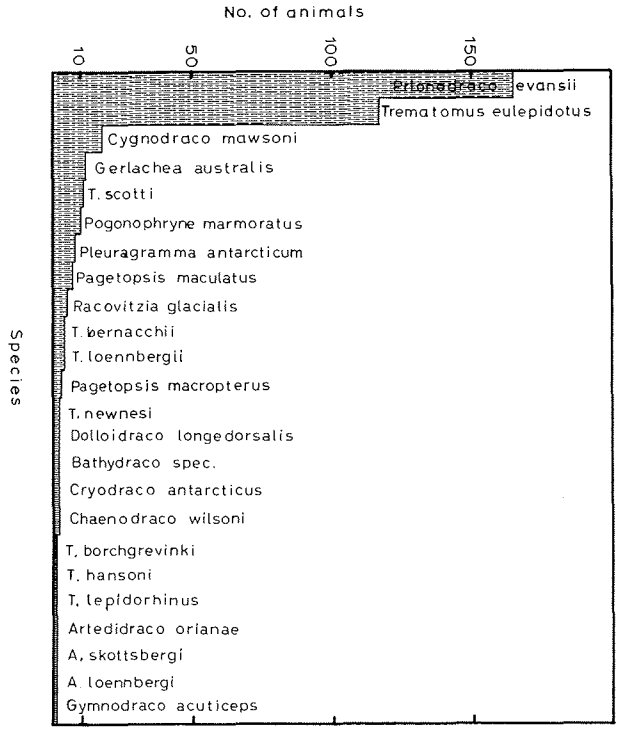

Fig. 4: Frequency of 24 fish species in catches taken in the southern Weddell Sea on board M/V POLARSIRKEL.

Abb. 4: Häufigkeitsverteilung der 24 gefangenen Fischarten aus der südlichen Weddell-See.

Species	tissue	cadmium C (ppb)
Euphausia crystallorophias	whole animal	6,23 ± 0,16
E. frigida	whole animal	9,62 ± 0,45
E. superba	carapace	9,84 ± 0,31
	pleon muscle	7,14 ± 9,49
Notocrangon antarcticus	carapace	2,35 ± 0,04
	pleon muscle	0,98 ± 0,09
Lobodon carcinophagus	blood	10,97 ± 0,90
	contents of colon	3,51 ± 0,14
	appendix	2,87 ± 0,05
	ileum	2,54 ± 0,05
	jejunum	1,74 ± 0,18
	duodenum	1,04 ± 0,06
	pancreas	0,98 ± 0,25
	liver	6,72 ± 0,61
	kidney	42,45 ± 0,70
	testicle	0,67 ± 0,05
	spleen	0,86 ± 0,03
Pygoscelis adéliae	musculus pect. major	0,45 ± 0,07
	heart	0,34 ± 0,03
	liver	19,76 ± 0,71
	kidney	173,01 ±12,34
	lung	4,28 ± 0,47
	bone (scapula)	0,06 ± 0,01

Tab. 4: Cadmium concentrations in different antarctic animals from the Weddell Sea (values in ppb dry weight).

Tab. 4: Cadmium-Werte verschiedener antarktischer Tiere aus der Weddel-See (Werte in ppb Trockengewicht).

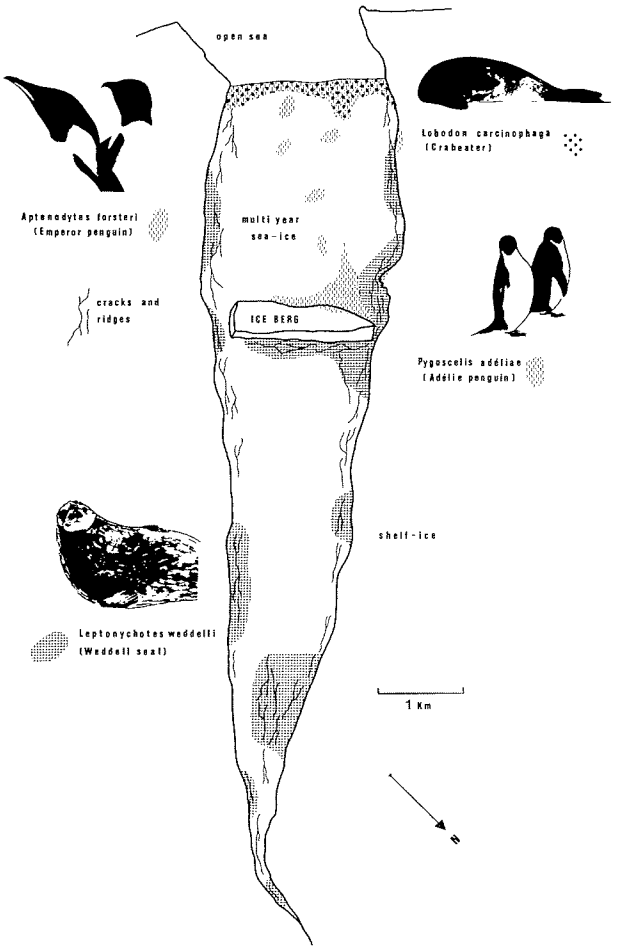

Fig. 5: The inlet — a typical Antarctic biotope. Distribution of seals and penguins in an Antarctic inlet, part of the shelf ice barrier, near Cape Norvegia.

Abb. 5: Das Inlet — ein typisches antarktisches Biotop. Die Verteilung von Robben und Pinguinen in einem antarktischen Inlet, einem Teil der Schelfeisküste bei Kap Norvegia.

great difference between these two groups in this respect. This is probably due to the different degree of heavy metal pollution in the two areas.

PCB analyses will be carried out in the near future.

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