The Expedition ANTARKTIS XV/3 (EASIZ II) of RV "Polarstern" in 1998

Edited by Wolf E. Arntz and Julian Gutt
with contributions of the participants

Ber. Polarforsch. 301 (1999)
ISSN 0176 - 5027

providing the diatom cultures for feeding-rate experiments, and to M. Rauschert for taking some nice photos of sabellids.

References

Barnes, D.K.A. and A. Clarke (1995). Seasonality of feeding activity in Antarctic suspension feeders. *Polar Biology*, 15: 117-131.

Dales, R.P. (1957). Some quantitative aspects of feeding in sabellid and serpulid fan worms. *J. mar. biol. Ass. U.K.*, 36: 309-316.

Gambi, M.C. (1997). Autecology of Aphroditidae and Polynoidae on the continental shelf and slope of the Eastern Weddell Sea. Ber. Polarforsch., 249: 66-73.

Gambi, M.C., A. Giangrande and F. P. Patti (submitted). Comparative observations on the reproductive biology of four species of *Perkinsiana* (Polychaeta: Sabellidae). 5th Polychaete Conference, Curitiba, Brazil, August 1998.

Giangrande, A. (1991). Behaviour, irrigation and respiration in *Eudistylia vancouveri* (Polychaeta: Sabellidae). *J. mar. biol. Ass. U.K.*, 71: 27-35.

Giangrande A. and M. C. Gambi (1997). The genus *Perkinsiana* (Polychaeta, Sabellidae) from Antarctica, with descriptions of the new species *P. milae* and *P. borsibrunoi*. *Zool. Scr.*

Riisgard, H.U. and N. M. Ivarsson (1990). The crown-filament pump of the suspension feeding polychaete *Sabella penicillus*: filtration, effects of temperature and energy cost. *Mar. Ecol. Prog.* Ser., 62: 249-257.

Rouse, G. and K. Fitzhugh (1994). Broadcasting fables: is external fertilization really primitive? Sex, size and larvae in sabellid polychaetes. *Zool. Scr.*, 23: 1-42.

2.3 Studies at the Drescher Inlet: Seals, Fish, Sea Ice and Hydrography

General objectives

The Drescher Inlet, a funnel shaped 20 km long crack in the Riiser Larsen Ice Shelf, is flanked by floating ice cliffs of up to about 30 m above and 150 m below the sea surface. The topography of the inlet is somewhat irregular with water depths ranging from 360 m to 430 m and the sea bed extends for unknown distances under the ice shelf. The area is characterized by large changes in the physical environment as strong gales and swell induce ice break up which is most intensive during late summer. When the fast ice cover recedes, large numbers of Weddell seals and crabeater seals haul out at the ice edge and at tidal cracks in the inner parts of the inlet. During that time, masses of organic material such as seal and penguin faeces and ice algae are released into the water column from the melting brash and platelet ice, an attractive food source for zooplankton, amphipods and krill especially in the surface layers. This again attracts pelagic fish and finally krill and fish feeding predators, the crabeater and Weddell seals. Knowledge of the trophic relationships between the top consumers and their prey and their ecological interaction with other biological key components and physical processes is fundamental for an improved understanding of the high Antarctic shelf marine ecosystems.

To gain new insights into of the seals' underwater environment, studies on the diving and foraging behaviour of Weddell seals (chapter 2.3.1) and migratory and diving behaviour of crabeater seals (chapter 2.3.2) are closely linked to studies on the role of algae communities in platelet ice for pelagic and benthic consumers (chapter 2.3.6), to the studies on vertical biomass distribution and diurnal migratory behaviour of pelagic fish (chapters 2.3.4 and 2.3.5), and to studies on the distribution and abundance of pack ice seals carried out by census surveys with helicopters of RV "Polarstern" (chapter 2.3.3). Here we present the preliminary results of the three working groups.

2.3.1 Diving and Foraging Behaviour of Weddell Seals (J. Plötz, H. Bornemann)

Objectives

The studies on Weddell seals are part of the EASIZ (Ecology of the Antarctic Sea Ice Zone) programme of SCAR closely linked to the APIS (Antarctic Pack Ice Seals) programme initiated by the SCAR-Group of Specialists on Seals.

Weddell seals are excellent divers highly adapted to reside in the coastal fast ice zone, a dynamic ecosystem that is strongly influenced by the seasonal ice break off. The primary objective was to investigate, during days of continuous recordings, the seals' diving and feeding activities using different types of electronic data loggers. A unique opportunity of this study is to compare the dive records of the seals with hydrographic events under the fast ice of the inlet (CTD-profiles provided by Dieckmann and Thomas, see chapter 2.3.6) and with data on the vertical biomass distribution and diurnal migratory pattern of pelagic fish (chapter 2.3.4) obtained by bentho-pelagic trawling in the same study area. Another important goal is to identify the seals' individual haulout periods. Knowledge of diurnal haulout patterns is important when adjusting estimates of seal abundance calculated from airborne censuses (chapter 2.3.3).

Work at Drescher Inlet

The study on Weddell seals was done in stages spread out over three weeks. From 7 to 13 February, calm and sunny weather contributed to the development of a stratified pycnocline at about 150 m. The period from 14 February onwards until the end of our field campain on 23 February was characterized by an intensive ice break up and mixing of the upper water layers (see chapter 2.3.6).

The Weddell seals were immobilized to achieve a reliable attachment of the logging devices. We used a combination of ketamine, xylazin, and diazepam. The initial doses of the drugs were administered by Telinject-blowpipe darts to minimize the seals' defence and flight responses. Thus, undue stress to the animals is prevented and the risk of adverse reactions to the anaesthesia reduced. Maintenance of immobilization, which lasted for 1.5 - 3 h, was achieved by small additional doses of ketamine and/or diazepam administered by hand. The mixture of ketamine, xylazine and hyaluronidase described as "Hellabrunner Mischung" (HM) contains 500 mg xylazin + 400 mg ketamin + 150 I.U. hyaluronidase. Seals were drugged with either one (body weight: 250 - 350 kg), two (350 - 450 kg), or three (450 - 550 kg) shots of 4.0 ml HM /seal. We reversed the anaesthesia by administration of the antidote yohimbine (0.5 mg/kg).

Preliminary results

We equipped 31 Weddell seals and got back 19 loggers of which 3 had failed. The remaining 16 loggers provided profiles of about 4,000 dives. Dive and haulout records were obtained for periods of up to 14 days. Most of the 16 data records overlapped by many days. The haulout behaviour of seals was affected by the ice situation. Under stable ice conditions they showed a fairly uniform haulout pattern with periods of about 8 to 14 hours at daylight. This regular pattern was somewhat disturbed during the intensive ice break up. During that time the seals dived, without interruption, for periods of 3, 4 and even 6 days. Seals did not necessarily haul out every day, and when on the ice, they again preferred the daylight hours around noon but for short periods of 3 to 6 hours. The majority of both pelagic and bottom dives lasted for about 20 min. It is of particular interest that the longest dives of more than 1 hour were made to about 150 m depth, and not (as expected) to the sea bottom at about 400 m. The maximum record of one pelagic dive was 78 min.

An explanation for the seals' ongoing diving activites during the ice break off might be that (as described above) masses of organic material released from the melting brush and platelet ice provided an attractive food source for zooplankton, that again attracted fish and finally the seals. Fig. 27 gives an example of a series of foraging dives to the three most preferred depth layers,

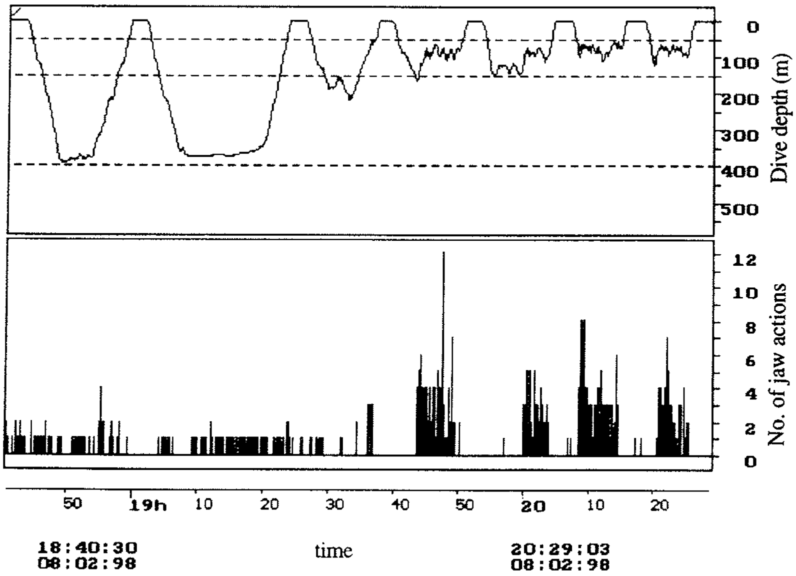

Fig. 27: Example of benthic and pelagic feeding dives of a Weddell seal. Note the increase of jaw action signals (below) of up to 12 mouth openings per 8 sec measuring interval during pelagic diving between the 50 and 150 m depth layer indicated by dotted lines.

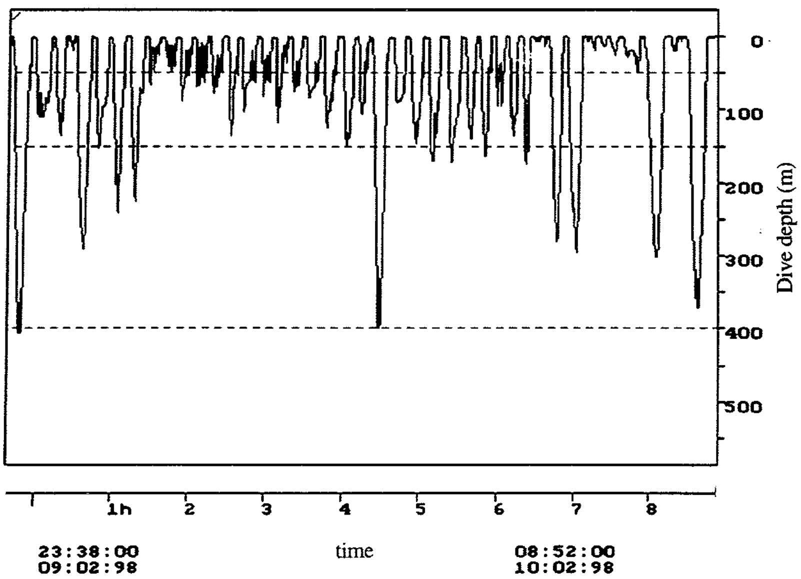

Fig. 28: Example of a typical dive pattern of a Weddell seal. The progressive change in dive depth may reflect the seal's response to vertical migration in fish.

i.e. 50 m, 150 m and 400 m. During benthic diving the seal opened its mouth mostly once per 8 sec-measuring interval. A significant increase in jaw action (up to 12 signals per 8 sec) coincided with the seal's switching from benthic to pelagic dives. These signals of feeding events (or at least prey catch trials) were most intensive within the 50 to 100 m pycnocline depth, where Knust *et al.* (chapter 2.3.4) caught a high biomass of vertically migrating *Pleuragramma antarcticum* followed by *Anotopterus pharao*, a pelagic fish predator.

Another characteristic feature of the feeding dives of Weddell seals is the pattern of a progressive change in the maximum dive depths (Fig. 28). During nighttime most foraging activities occurred in the pycnocline depth between 50 and 150 m. We infer that this typical pattern of an arch-like dive profile reflects the seal's response to vertical migration in fish, a phenomenon that was also observed in *Pleuragramma antarcticum* and *Anotopterus pharao* caught by pelagic night hauls (Knust *et al.*, chapter 2.3.4). As far as we know, this is the first record of vertical migratory behaviour in both the Weddell seal and Antarctic fish.

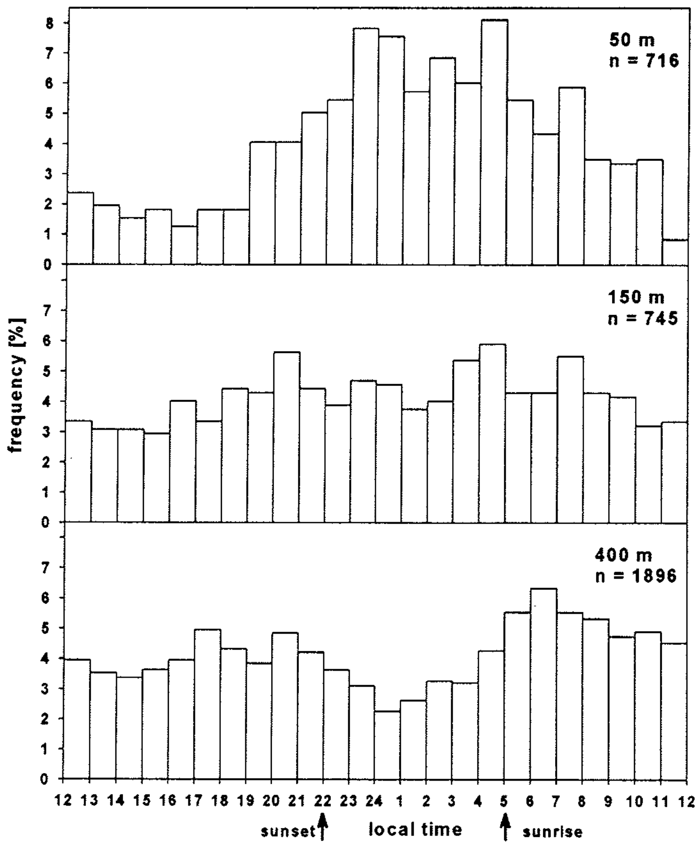

Fig. 29: Frequency distribution of the depths of dives (n = 3357) against time of day. The dive records of 16 Weddell seals were placed into three depth categories.

Fig. 29 represents an overview of most of the dive records obtained. A total number of 3357 dives was roughly categorized into the seals' three preferred depth ranges of 50 m, 150 m and 400 m. The percentage frequency distributions of these dives indicate an increase of pelagic dives during nighttime with a distinct maximum in the 50 m water layer, a broad maximum in the 150 m layer and a minimum of night dives to the sea bottom at about 400 m depth.

2.3.2 Satellite Tracking of Crabeater Seals (H. Bornemann, J. Plötz)

Introduction and objectives

The studies on crabeater seals are part of the international APIS (Antarctic Pack Ice Seals) programme of the SCAR Group of Specialists on Seals. Next to the seal census surveys (see Bester and Odendaal, see chapter 2.3.3) a key element of this programme is to determine seasonal movements, haulout and diving behaviour of crabeater seals by using Satellite-linked Dive Recorders (SDR). To obtain a comprehensive picture of the seals' behaviour in their three-dimensional environment these data need to be interpreted in the context of both biological and physical parameters of the seals' marine environment. The data will be related to information on prey dynamics, ice characteristics and distribution, water column physics and ocean currents by using the information system SEPAN (see below). The data will also provide haulout correction factors to improve the accuracy of the seal census design.

Work at Drescher Inlet

Immobilization of the crabeater seals has been done as described above (see chapter 2.3.1). Crabeater seals were drugged with lower doses of 2 - 3 ml HM, which were supplemented by 2 - 3 ml ketamine (100mg/ml). Body length and girth measurements were taken. We equipped 15 crabeater seals (Table 27) with satellite-linked dive recorders (SDR) between 28 Jan and 6 Feb 1998. The SDRs (SDR T6, Wildlife Computers, USA) are designed to provide at-sea locations through the Service ARGOS system (CLS / Service Argos, France) during the seals' foraging migrations. While at sea the SDRs also process data on the seals' diving behaviour in the form of histograms. These histograms are encoded into messages and transmitted to polar-orbiting satellites. The accessed data provide both the horizontal extent of the seals' migration and the vertical distribution of their dive depths.

Table 27: Tracking periods of crabeater seals and last locations (20.03.98) during EASIZ II.

No.	Sex	Start	End	Last location
1	M	28-01-98	04-03-98	71.961° S, 33.247° W
2	M	29-01-98	05-02-98	73.611° S, 38.257° W
3	F	29-01-98	29-01-98	72.877° S, 19.131° W
4	M	01-02-98	01-02-98	No data
5	M	01-02-98	18-02-98	71.926° S, 27.855° W
6	M	01-02-98	*	
7	M	01-02-98	*	
8	M	01-02-98	*	
9	F	02-02-98	*	
10	M	03-02-98	*	
11	M	03-02-98	14-03-98	70.416° S, 37.236° W
12	M	03-02-98	13-03-98	72.344° S, 44.679° W
13	M	04-02-98	06-02-98	72.830° S, 19.844° W
14	F	04-02-98	*	
15	M	06-02-98	21-02-98	67.108° S, 14.889° W

F = female M = male *still transmitting (20-03-98)

Preliminary results

The animals left the Drescher Inlet between 1 and 5 days after they had been equipped with SDRs. During the first two weeks the seals migrated in different directions. The migratory