Advances in studying the foraging behaviour of Weddell seals

H. Bornemann, J. Plötz, M. Schröder, V. Strass, G. Rohardt

Alfred-Wegener-Institute for Polar and Marine Research * Columbusstraße * Bremerhaven * Germany

Objectives

Weddell seals are the most southerly ranging pinnipeds. Knowledge of their foraging behaviour and diet is important to understand the role they play as top predators in the marine ecosystems of the high Antarctic shelves. Information obtained by analyses of stomach contents allows biologists to determine prey types and sizes but not where feeding actually takes place. To obtain a more comprehensive picture of the foraging activity of seals we conceived a new system of electronic recorders.

Methods

Fig. 3 Weddell seal with time-depth recorder. We deployed electronic devices on adult seals to measure dive depth and jaw activity simultaneously. The seals were chemically immobilized and recaptured after several days or weeks and the recorders recovered.

Results

The following analysis is based on a data record of 757 dives obtained from an adult seal between 2 and 23 February 1995. **Fig. 4** shows principal types of a pelagic (**A**), a benthic (**B**) and an orientation dive (**C**).

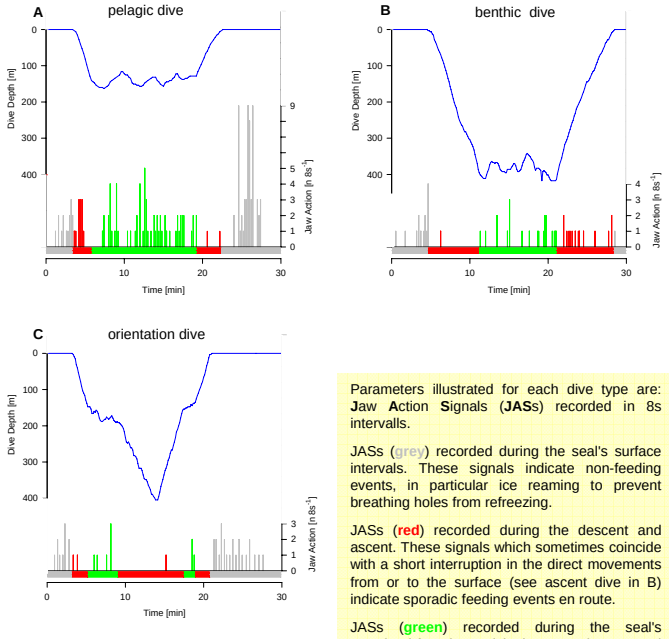

Fig. 4 c Orientation dive. This type of deep dives was the least common and accounted for 6.7% (n=51) of the seal's dives (n=757). All orientation dives showed a few PPMs and JASs during descent and/or ascent but no sustained PPM at their maximum depth.

Parameters illustrated for each dive type are: **J**aw **A**ction **S**ignals (**JAS**s) recorded in 8s intervalls.

JASs (grey) recorded during the seal's surface intervals. These signals indicate non-feeding events, in particular ice reaming to prevent breathing holes from refreezing.

JASs (**red**) recorded during the descent and ascent. These signals which sometimes coincide with a short interruption in the direct movements from or to the surface (see ascent dive in B) indicate sporadic feeding events en route.

JASs (**green**) recorded during the seal's sustained foraging activity between descent and ascent. The vertical zig-zag pattern is defined as the seal's **P**rey **P**ursuit **M**ovement (**PPM**). These up and down excursions were commonly displayed within a range of 50 m both at midwater depths and at depths close to the sea bottom.

Fig. 5 Frequencies of dive depth and jaw activity in relation to hydrographic features

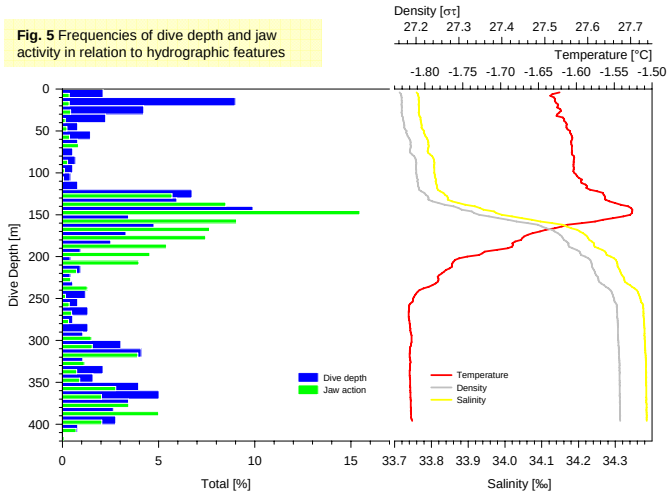

Fig. 5 represents the frequency of the median maximum depths (**blue**) of all 757 dives distributed in 10 m ranges. Also included are 8218 JASs (**green**) recorded during the pelagic and benthic PPMs.

Pelagic dives to 150 ± 50 m and benthic dives to 350 ± 50 m do not differ significantly in number (249 : 252). However, the median duration of PPMs in pelagic dives (7.9 min) is about 2-fold longer than in benthic dives (4.1 min). This is strongly reflected by the seal's feeding activity being most intensive during the pelagic PPMs (pelagic : benthic JASs = 5251 : 2117).

The histogram is related to a CTD profile recorded on March 5th at the Drescher Inlet. Striking is the strong correlation between jaw action and water temperature (**red**) as well as density (**grey**) and salinity (**yellow**) exclusively in 150 ± 50 m dive depths. This is even more pronounced just in the 150 m-column where the seal's jaw activity maximum corresponds exactly to the water temperature maximum of -1.53° C.

Study area

Field studies on Weddell seals were carried out at the Drescher Inlet (**Fig. 1**), eastern Weddell Sea coast, from 18 January to 5 March 1995. The establisment of an igloo camp on the ice shelf above the inlet (**Fig. 2**) was achieved by the support from two helicopters of the RV "Polarstern".

The Drescher Inlet, a funnel-shaped crack in the Riiser-Larsen Ice Shelf, is 25 km long and flanked by floating ice cliffs up to 30 m high. The sea-bed outside the inlet exceeds the 500 m isobath about 5 km off the entrance. The topography of the inlet itself is somewhat irregular with water depths ranging from 380 to 420 m extending for unknown distances of probably several km under the ice shelf; shallow areas do not exist. Tidal cracks along the foot of the ice cliff and across the entire inlet provided breathing holes for at least 500 Weddell seals resting there on the ice during the peak haulout period.

Conclusions

This is the first report of jaw activity patterns of a diving seal. Although the number of **J**aw **A**ction **S**ignals (**JAS**s) can not provide information on the number of prey actually ingested, we infer that:

- the majority of JASs during dives has to do with feeding events or at least prey catch trials
- the number of JASs indicates prey density
- the seal's foraging is highly correlated with the thermocline depth where prey may aggregate
- diving to midwater depths has the advantage of increasing the amount of time spent submerged between descent and ascent, and as a consequence, foraging success

Alfred-Wegener-Institut
für Polar- und Meeresforschung
in der Helmholtz-Gemeinschaft

H. Bornemann, J. Plötz
Ecology & Ecophysiology Section
hbornemann@awi-bremerhaven.de
jploetz@awi-bremerhaven.de

M. Schröder, V. Strass, G. Rohardt
Physics I Section
mschroeder@awi-bremerhaven.de
grohardt @awi-bremerhaven.de
vstrass @awi-bremerhaven.de

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