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Winter foraging hot spots of southern elephant seal males from King George Island and oceanographic features

Foraging movements

Fifteen adult southern elephant seal males of the colony at Stranger Point on King George Island / Isla 25 de Mayo, were instrumented with ARGOS CTD-tags in April 2010. Seals travelled on extended latitudinal gradients in the Scotia or the Bellingshausen Sea. As far as we could track individuals, the majority of the post-moult movements were oriented to the east. Three seals remained in the vicinity of the South Orkney Islands (61°S 45°W), and six moved further north to South Georgia (55°S 38°W). Another three seals stayed in the Bransfield Strait (60°S 63°W), and two moved to and around the tip of the Antarctic Peninsula where transmissions ended prematurely off Joinville Island (64°S 53°W) and Larsen "B" Ice Shelf (66°S 62W). Two males travelled in the opposite direction far south over the shelf of the Bellingshausen Sea, with last locations recorded off Charcot (70°S 80°W) and Thurston Island (72°S 102°W); the latter seal then moved to South Georgia and back to the Powell Basin. All straight line single (3) and return tracks (3) towards South Georgia took place before and after the breeding season. The pattern of movements seem to contradict implications for sexual segregation interpreted from earlier studies, suggesting more overlap between foraging grounds of adult males and females then previously assumed. The seals' long and straight line movements at distances of more than 1500 km allowed for cross sectional analyses of hydrographic features and revealed data on the temperature and salinity regime during winter (Fig. 1). All seals tracked over long time periods showed extended residence times at circumscribed at-sea locations, considered as foraging hot spots (Fig. 2). These spots were widely distributed within the Scotia Sea, the northern Weddell Sea, and the Bellingshausen Sea and coincide with bathymetric features such as slopes, plateaus and seamounts (Fig. 3).

Seal-borne oceanography

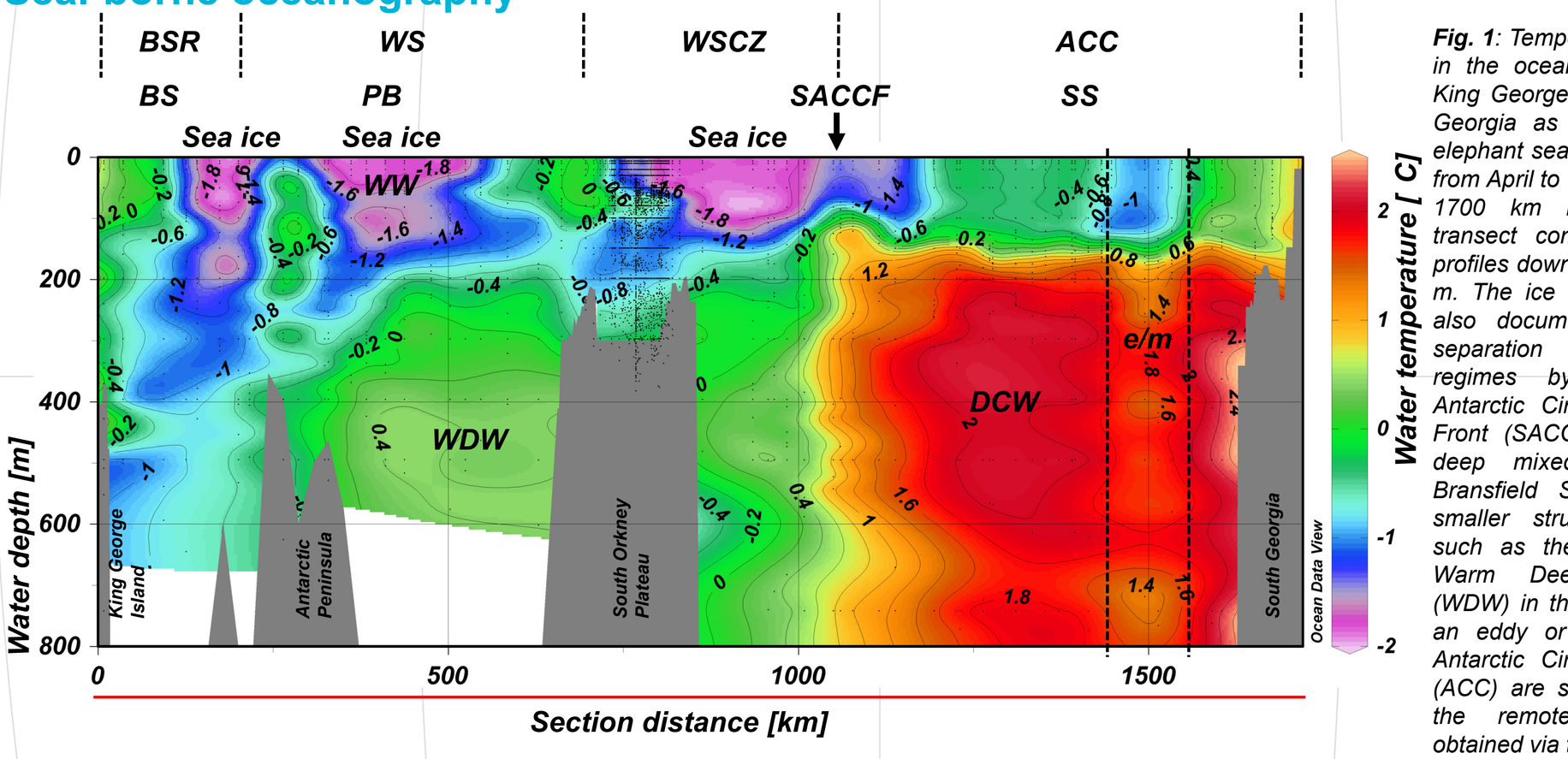

Fig. 1: Temperature distribution in the ocean region between King George Island and South Georgia as measured by an elephant seal during the period from April to October 2010. The 1700 km long temperature transect comprises 540 dive profiles down to a depth of 800 m. The ice cover in winter is also documented as is the separation of the oceanic regimes by the Southern Antarctic Circumpolar Current Front (SACCF) and the very deep mixed layer in the Bransfield Strait (BS). Even smaller structures at depth such as the location of the Warm Deep Water core (WDW) in the Powell Basin or an eddy or meander of the Antarctic Circumpolar Current (ACC) are shown in detail by the remote sensing data obtained via the seals.

See legend for abbreviations as inserted in figure.

ACC	Antarctic Circumpolar Current	e/m	eddy or meander of ACC	WDW	Warm Deep Water
BS	Bransfield Strait	PB	Powell Basin	WS	Weddell Sea
BSR	Bransfield Strait Regime	SACCF	Southern Antarctic Circumpolar Current Front	WSCZ	Weddell Scotia Confluence Zone
DCW	Circumpolar Deep Water	SS	Scotia Sea	WW	Winter Water

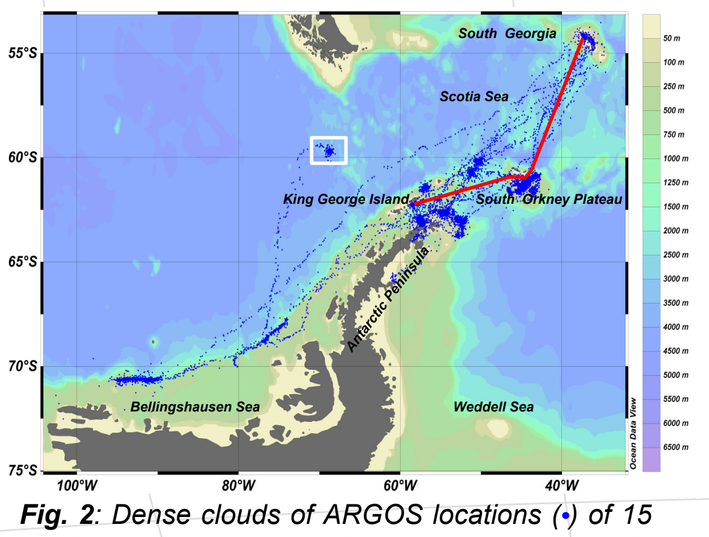

Fig. 2: Dense clouds of ARGOS locations (•) of 15 adult southern elephant seal males indicate productive winter foraging zones in the Scotia Sea, Weddell Sea, and Bellingshausen Sea between April and October 2010. The red line represents the transect between King George Island and South Georgia via the South Orkney Plateau as given in Fig. 1 (above). The white rectangle represents the detail as given in Fig. 3. All relevant bathymetric and topographic features are labeled, unless geo-codes are given directly in text.

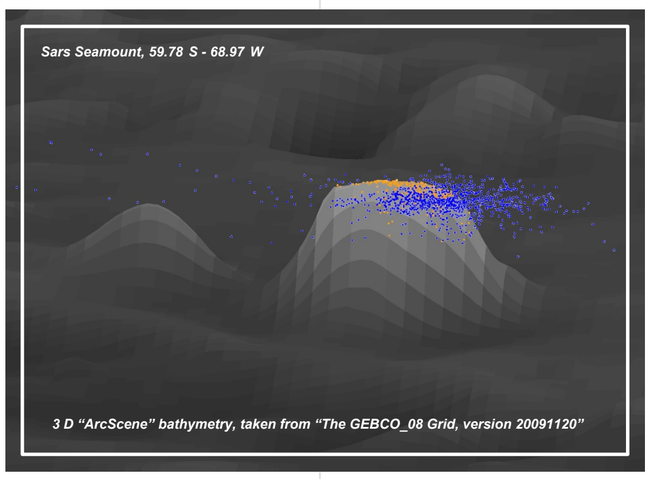

Fig. 3: ARGOS locations (••) indicate a foraging spot over Sars Seamount. The pattern of dots shows the spatial compression of individual dives over the top and upper slopes of the seamount. Surrounding sea floor depths exceed 4000 m, while dive depths went down to over 2300 m. Blue dots are projected to the seal's maximal dive depths, orange ones to the seafloor, as they indicate mis-matches between predicted bathymetry and dive depths (n = 412). Summit predictions up to 27 m below sea level are high likely overestimations, since median deviations between the seal's dive depth and bottom depths amount to 280 m. ARGOS location accuracy contributes to these mismatches as well.

Foraging behaviour and oceanographic features

Modeling of data of the seals' diving behavior in relation to oceanographic features by using standard linear mixed-effects models indicates that the seals' : …

- …speed of travel is particularly influenced by "track stage" (post moulting *vs* post breeding), seafloor depth, sea ice concentration, and the water temperature at the deepest maximum dive depths;
- …bottom-time residuals (above mean) are influenced by seafloor depth, as well as roughness of seafloor topography and steepness of slope;
- …dive durations seem to have some level of influence on virtually all of the afore-mentioned environmental parameters.

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All seal data and corresponding meta information are available in open access via PANGAEA Data Publisher for Earth & Environmental Science (www.pangaea.de).