8. DISTANCE SAMPLING SURVEYS FOR CETACEANS IN ANTARCTIC WATERS

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Objectives

Knowledge on distribution, density and abundance of cetaceans in the Southern Ocean is rather limited. Especially in pack-ice regions, little research has been conducted as only few vessels can penetrate into the ice. In previous studies (Kock et al., 2009; Scheidat et al., 2011) we confirmed earlier investigations (Plötz et al., 1991; van Franeker, 1992) and showed that in the Southern Ocean ship-based helicopters provide a useful platform to survey marine mammals not only in open water but also in pack-ice. By means of a dedicated aerial and shipboard cetacean sighting survey following standard line-transect distance sampling methodology, our project aimed to contribute to solid base-line data on cetacean occurrence and abundance, needed by decision makers for management and conservation plans. In addition, behavioural observations were to investigate potential responsive behaviour of cetaceans towards vessels in Antarctic waters.

Work at sea

Aerial surveys

Aerial surveys following standard line-transect distance sampling methodology (Buckland et al., 2001) were conducted with the two helicopters (BO 105) of RV *Polarstern*. The duration of survey flights ranged from 15 minutes to 2 hours with an average duration of 1 ½ hours. Surveys were planned in an "ad-hoc" way, depending on the position and the track of RV *Polarstern* as well as the actual weather conditions.

Survey flights were conducted at 600 feet with a speed of 80-90 nm per hour. Two observers were positioned in the back of the helicopter and were observing the area to the right and to the left side of the helicopter, respectively. The third observer was seated in the port front seat of the helicopter observing the area to the front, focusing on the transect line. The observer in the right back seat of the helicopter used the VOR software, designed by Lex Hiby and Phil Lovell and described in Hammond et al. (1995), to continuously store GPS data, data on environmental conditions (sea state, cloud cover, glare, ice coverage, overall sighting conditions) and sighting data.

For each sighting of a marine mammal in the water the following data were collected: species, distance to transect (via declination angle), group size, group composition, behavior, cue, swimming direction and potential reaction to the helicopter. Inclinometers were used to measure the declination angle to each sighting when abeam the helicopter. With the known survey altitude, this angle will be used to calculate the distance of the sighting to the transect line. Using the software *Distance* (Thomas et al., 2010) the effectively searched strip widths for the different cetacean species can be estimated post-survey. Furthermore, swimming penguins, vessels, and floating debris were recorded.

If a sighting occurred and species or group size could not be identified, the survey was interrupted to approach the sighting for closer inspection. After identification the helicopter returned to the transect line and the survey was continued (closing mode). Digital photography was used for species identification.

Shipboard survey

A ship based survey following line-transect distance sampling methodology was conducted from the crow's nest platform with two observers scanning the area in front of the vessel. The two observers were situated in wooden observer boxes located on the left and right side of the platform. The scanning was done naked eye but binoculars were used to identify species and group sizes. An additional team member was situated inside the crow's nest operating as data recorder. During shipboard observations the same information on environmental and sighting conditions as for the aerial surveys was collected. Surveys were generally conducted if *RV Polarstern* had a speed of at least 7 knots. Some observations were done in lower speed while breaking through ice.

Tracking

To investigate potential responsive behaviour of whales towards the survey vessel, high powered binoculars (Big Eyes) were used to follow the track of detected animals as long as possible, while the ship passed by the sightings. These behavioural studies were conducted from the crow's nest. "Tracking", however, is only possible under perfect weather conditions with winds of less than 3 Bft, good visibility (clear horizon), a low swell and no ice breaking activity of the ship. These conditions were not given during this cruise and hence, tracking could not be performed.

Preliminary results

Aerial surveys were conducted from 6 to 16 December 2011. During this time, a total of 11 flights were conducted, adding up to 15½ hours of survey, covering 2030 km. During these surveys 6 cetacean sightings with a total of 9 animals were made. Overall, 5 different species were identified. Table 8.1 gives an overview of the number of sightings and animals for all cetacean species encountered.

During the shipboard survey a total of 70 hours was surveyed on effort, covering about 700 nm (estimate based on total hours of effort and assuming average speed of 10 knots). 9 cetacean sightings, totaling 10 animals, were recorded (Table 8.1). All cetacean sightings made from the crow's nest occurred south of the ice edge and consisted either of Antarctic minke whales (*Balaenoptera bonaerensis*) or unidentified baleen whales.

On the southbound leg of the cruise, from Cape Town to Neumayer Station III, bad weather with high sea states and low clouds repeatedly hampered our survey work. Between 40°S and 55°S four helicopter flights and 17 ½ hours of observations from the crow's nest were conducted. One fin whale (*Balaenoptera physalus*), one humpback whale (*Megaptera novaeangliae*), one southern bottlenose whale (*Hyperoodon planifrons*), one unidentified large whale and a group of hourglass dolphins (*Lagenorhynchus cruciger*) were recorded in this area. In the vicinity of the ice edge, bad weather conditions with fog and high sea states made systematic observations impossible.

The vessel entered the pack-ice at 58°S. Sea ice coverage was very high during the whole passage from the ice edge to the shelf ice edge. Only two species were seen in waters covered by sea ice; these were the Antarctic minke whale and a group of southern bottlenose whales, which was encountered at 68°S in an area of 70 % sea ice coverage.

Due to the accident of the board helicopters on the way to the Neumayer Station III on 17 December, helicopter surveys could neither be conducted in the coastal polynya and adjacent areas close to the Neumayer Station III, nor for the rest of the cruise.

When *Polarstern* left Neumayer Station III on 22 December, the distance-sampling surveys from the crow's nest where continued, recording further sightings of Antarctic minke whales and one sighting of an unidentified baleen whale. Strong winds and fog where the steady companions of RV *Polarstern* on her way north, often making systematic counts of cetaceans impossible. Fig. 8.1 gives an overview of the positions of all cetacean sightings and the survey effort from the aerial survey and shipboard observations combined.

Publication in scientific journals in the fields of marine biology and zoology and presentation on scientific conferences will make the data available for science and public.

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Table 8.1: Cetacean sightings by species from the aerial and shipboard surveys during ANT-XXVIII/2

Species	**Number of groups**	**Number of individuals**
Antarctic minke whale (*Balaenoptera bonaerensis*)	5	6
Humpback whale (*Megaptera novaeangliae*)	1	1
Fin whale (*Balaenoptera physalus*)	1	1
Southern bottlenose whale (*Hyperoodon planifrons*)	2	3
Hourglass dolphin (*Lagenorhynchus cruciger*)	1	3
Unidentified baleen whale	5	5
Total	**15**	**19**

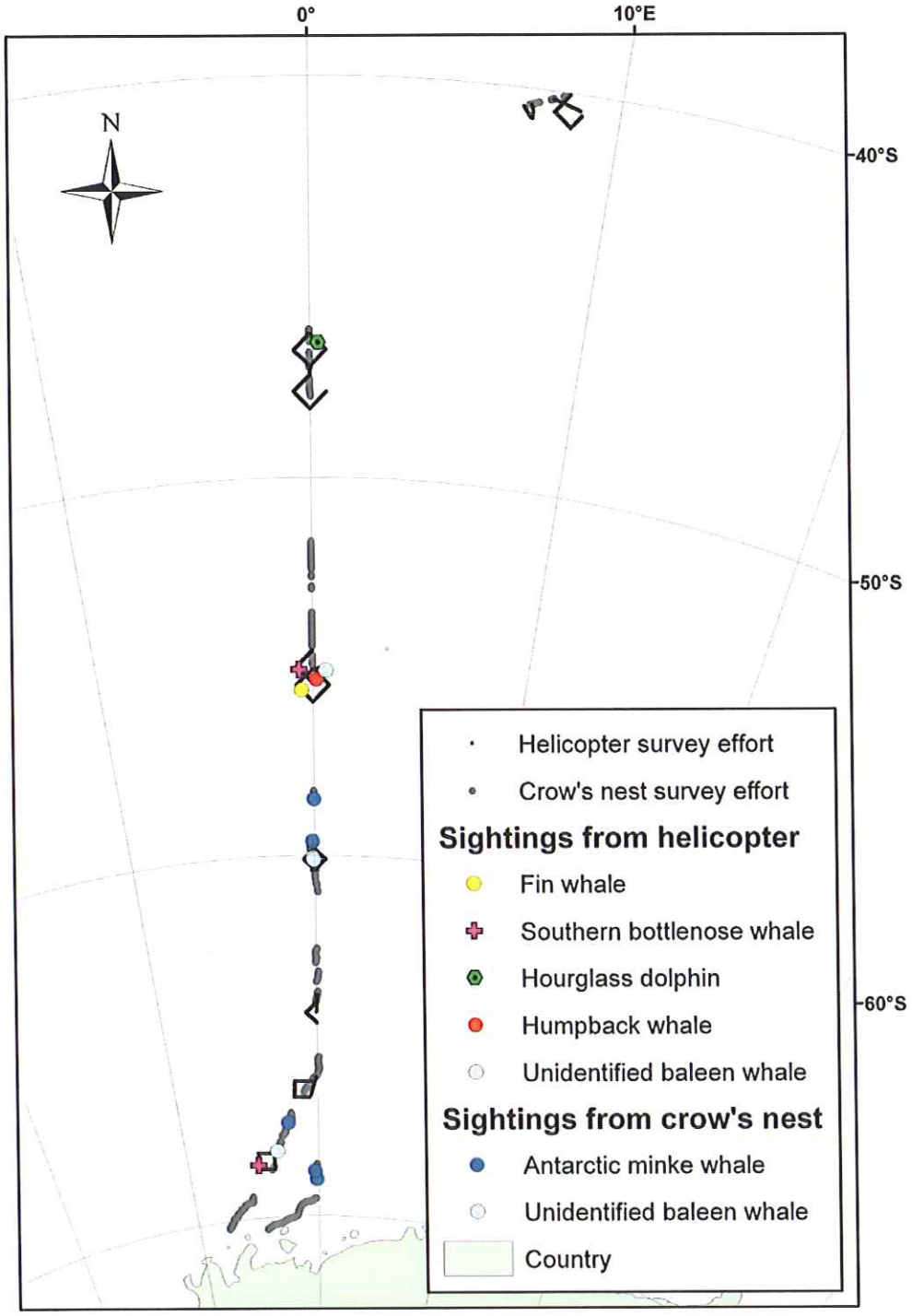

Fig. 8.1: Survey effort and distribution of cetacean sightings along the cruise track

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with contributions of the participants

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