TEST OF THE ELAC NDS3070 COLLISION AVOIDANCE SONAR IN THE BAY OF BISCAY

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Objectives

To mitigate the acoustic impact of seismic surveys on the marine environment tools are under development which allow to monitor safety radii around and beneath RV Polarstern within which at least some species of marine mammals are likely to be subject to behavioural disturbance and/or physical damage due to the received sound pressure levels (e.g. temporary or permant threshold shifts). According to the regulations defined by the National Marine Fisheries Service, USA the 180 dB_{RMS} sound pressure level is presently considered to be the threshold above which marine mammals might possibly experience temporary threshold shifts.

Internationally, three methods for monitoring the safety radii are applied: (1) Visual monitoring, (2) passive acoustic monitoring, (3) active acoustic monitoring. For RV Polarstern visual monitoring is realized by binoculars and, for spatially limited sectors, by infrared cameras. For passive acoustic monitoring a 600 m long streamer consisting of three 10 m long sections á 5 hydrophones has been developed. This test study is intended be a first step towards the development of an active acoustic monitoring system, which has the advantage that marine mammals neither have to be visible at the sea surface nor have to vocalize to be detected, as is necessary for visual or passive monitoring systems.

The ELAC NDS3070 collision avoidance sonar has been selected as a potential first prototype for an active whale detection sonar for RV Polarstern. In its active panorama mode the ELAC NDS3070 collision avoidance sonar operates with 30 kHz and allows to monitor a spherical sector of 360° horizontal and 26° vertical angle (from sea surface) around the ship. Assuming a detection probability of 90% and a false alarm rate of 0.5% theoretical computations show that an object with a target strength of -6 dB can be detected up to 1500 m distance (under ideal sea and velocity conditions). A value of -6 dB was chosen because it is approximately the minimum target strength of a small whale hit at its head or tail by sound waves. To test this active sonar under "real" conditions the sonar head will be installed in the moon pool and sonar signals will be generated and received by mobile transmission and receiving cabinets brought onboard RV Polarstern for this study. Objectives are :

(1) to test if such sonar systems can generally be used for marine mammal detection in the presence of the rather loud background noise of RV Polarstern,

(2) to determine the detection ranges for an object of known target strength under the "real" environmental conditions prevailing during the test study in the Bay of Biscay.

Sea trials

The Sonar tests was started in the Bay of Biscay on16.10.05; 21.00 h; at location 46° 24’ N; 05° 55’ W, and was completed on 18.10.05; 06:00 h; at location 46° 17’ N; 05° 58’ W. A sound velocity profile in the test location was measured by using a CTD-system down to 500 m water depth. This sound velocity profile was used for the theoretical computation of detection ranges under the actual environmental conditions. Subsequently, an object (triple mirror) with a calibrated target strength of -6 dB was deployed and positioned in a certain water depth of 70 m and 170 m respectively by appropriate buoys and weights. The target was acoustically measured by various angles and distances using a spiral-shaped course so that its detect ability can be verified as function of angle and range (Fig. 1 and Fig. 2). This experiment was repeated for different ship’s speeds and different acoustic noise produced by other active sonar like Hydrosweep, Parasound, fishery sonar and Dolog. The sea trials was also repeated for different water depths (70 m, 170 m) of the triple mirror.

The position of the triple mirror was recorded by using a recording GPS-receiver fixed on the buoy. The distance between ship and target was acoustically measured and will be later calculated by using the potion data from the target and the ship.

First results

The tests have shown that the used sonar system is able to acoustically detect target of –6 dB in the horizontal range between 200 and 1000 m and in the vertical range between 50 and 200 m in both frequencies 30 and 70 kHz. The detect ability was strongly affected by the noise produced by other active sonar. The here tested system is able to detect objects like whale in the mentioned range and if a narrow band filter (± 0,5 kHz) is used by the receiver units.

Fig. 3 shows a screen shoots of target and ship noise produced by propeller and other machineries.

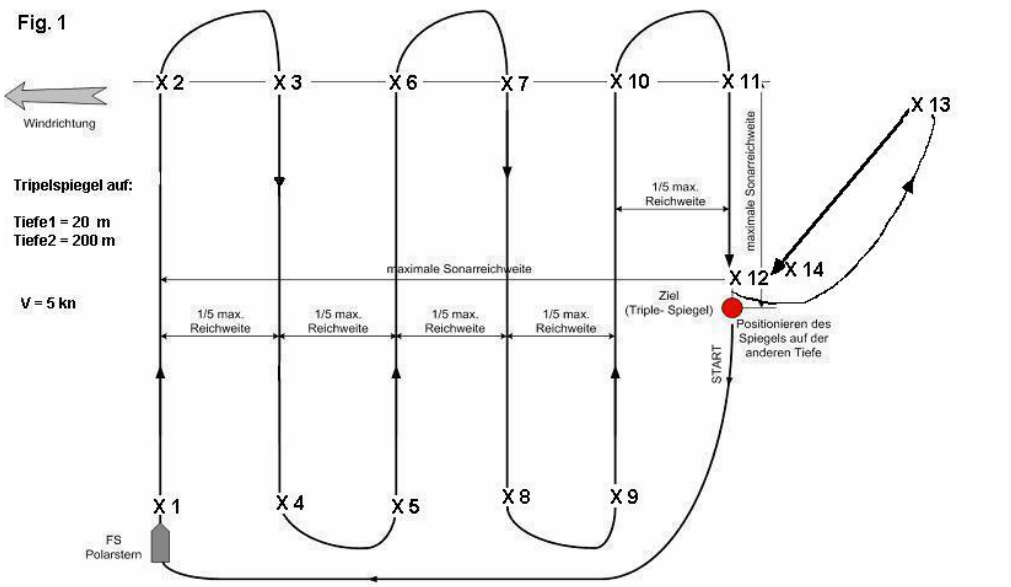

Fig. 1: The first test scenario. Course track for RV Polarstern approaching the calibration target (triple mirror) by various angle.

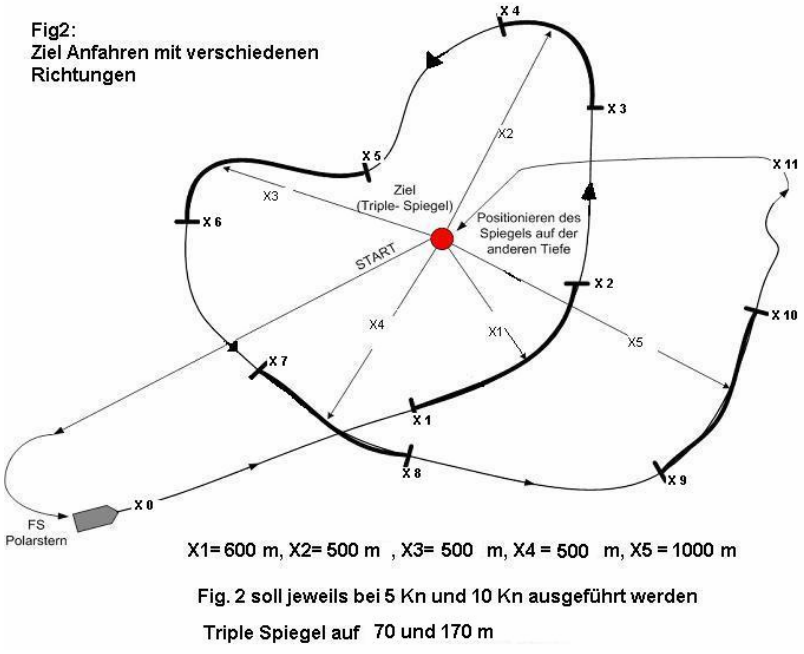

Fig. 2: The second test scenario for different ship' s speeds

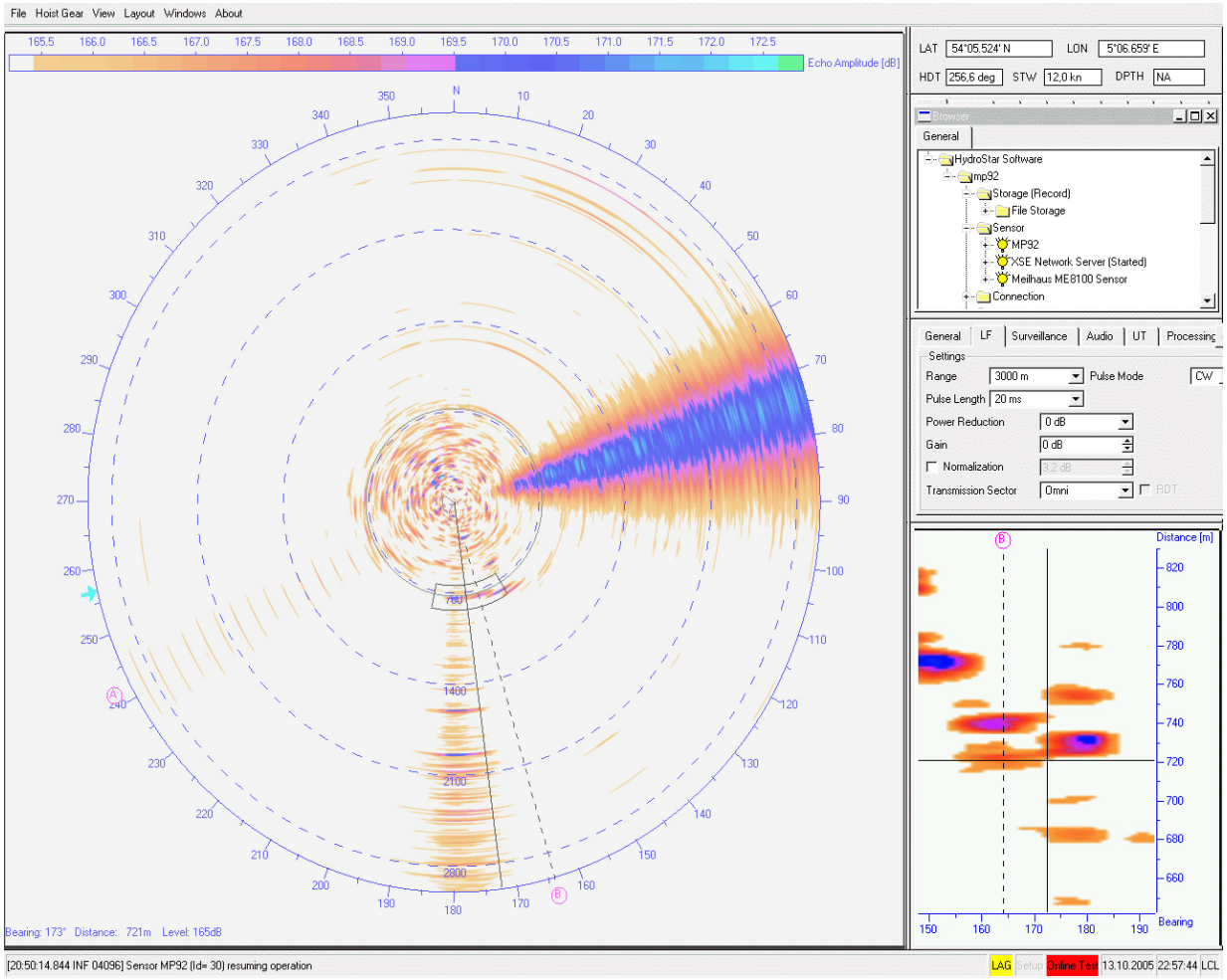

Fig. 3 Shows a screen shots of target and ship noise produced by propeller and other machineries.