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Agenda Item 6.5.2: **Review of new information on pollution, underwater sound and disturbance: Military, including munitions**

Mitigating the impact of detonating unexploded ordnance in the Baltic Sea – an example from the "marine area of the eastern Kiel Bight" protected under the EC Habitats Directive

Submitted by: **GSM – Society for the Conservation of Marine Mammals**

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Mitigating the impact of detonating unexploded ordnance in the Baltic Sea - an example from the “marine area of the eastern Kiel Bight” protected under the EC Habitats Directive

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Re: Item 6.5.2 (Military, including munitions) of AC meeting in San Sebastian, 19-21 April 2007

Off the Schleswig-Holstein coast, about 2.5 km from the town of Heidkate, 70 torpedo heads (350 kg TNT each) and sea mines (150 kg TNT each) were discovered on the sea floor at a depth of 10 m. After 60 years the torpedo casings have corroded and disintegrated. TNT fragments are entering the marine environment. In October 2006 the Ministry of the Interior of the Federal State of Schleswig Holstein started to detonate the unexploded warheads without observing the requirements pursuant to the EC Habitats Directive.

In this area, harbour porpoises of both Baltic Sea populations can occur, the critically endangered eastern population especially during autumn and winter (cf. Koschinski 2002). This is also the time preferred by the authorities for carrying out the detonations because the area has a high value as a tourist region during summer.

Underwater explosions represent the loudest point sources of anthropogenic noise in the sea. An extremely short rise time of the signal poses a threat to marine mammals and fish.

The maximum pressure of an explosion in relation to the charge can be estimated using the formula

$P_{peak}=5.24x10^{13}(W^{1/3}/R)^{1.13}$ µPa

with W= charge weight in kg and R= distance from explosion in m (Richardson et al. 1995). For a 350 kg TNT charge this results in a source level of 294 dB (re 1µPa@1m). In the shallow waters of the eastern Kiel Bight horizontal spreading and multipath propagation (from reflections at the surface and the bottom) can be assumed to create an unpredictable sound field rather than linearly decreasing sound levels. A sound propagation model (Porter 2007) has revealed a transmission loss of approximately 70 dB at a range of 10 km for the 1.5 kHz portion (In a conservative approach calculations were carried out for muddy bottom which absorbs more sound energy than does sand).

Marine mammals and fish are directly threatened. Especially gas filled cavities (ears, lungs, intestines, fish swimbladders) are in danger of being ruptured (Richardson et al. 1995). Marine mammals exposed to such strong sounds can suffer deadly injuries, acoustic trauma, permanent or temporary threshold shift (PTS and TTS).

In order to prevent marine mammals from being harmed through loud sound emissions such as military sonar, ramming noise or seismic operations it is suggested that a safety zone be visually and acoustically monitored before introducing sound into the water (Marine Mammal Risk Mitigation Project 2006). If marine mammals are recorded within this zone (which yet has to be defined for the explosions in Kiel Bight) operations must be stopped immediately.

However, high-intensity sound sources such as explosions require a vast safety zone which cannot be effectively monitored. Deterring marine mammals from the danger zone using ADDs or AHDs seems impossible due to the large extension of this zone. The deterrent range of an ADD is in the order of 160 m (Culik et al. 2001), while an AHD was avoided by over 90 % of harbour porpoises at a range of 3.5 km (Olesiuk et al. 2002) which is much less than the assumed danger zone.

One option would be to reduce the sound level drastically at the source. A mitigation measure which should be taken into account is a bubble curtain (Würsig et al. 2000). Diameter of the bubble curtain and bubble size are critical for the degree of sound reduction and the frequency band in which sound energy is reduced by reflections within the curtain.

The best option from a conservationist point of view is to recover the warheads instead of blasting them in place. A safe recovering procedure offered for salvage operations consists in freezing the explosives and surrounding water using supercooling equipment and liquid nitrogen. Submerged explosives are frozen and then lifted with the aid of lifting gear or are brought to the surface by means of floaters. The objects remain frozen throughout all further treatment and transportation. The advantages are a high resistance of ice to pressure (similar to that of concrete) and a high tensile strength due to the ice encasement. With this method, disintegrated warheads can be stabilised and sealed against water or air. Further, due to the low temperature within the encasement chemical reactions of explosives are decelerated. For more details see: (http://www.nordseetaucher.de/frame.php?page=suchen.php&lang=en).

In light of the critical situation of the Baltic harbour porpoises, competent authorities should make every effort to ensure that the unexploded ordnance is recovered in line with requirements under the EC Habitats Directive and without subjecting marine life to the threat of being seriously harmed.

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