Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities

Module B.6.

Polar Bears

The full CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities and the stand-alone modules are online at:

cms.int/guidelines/cms-family-guidelines-EIAs-marine-noise

B. Expert Advice on Specific Species Groups

The sea is the interconnected system of all the Earth's oceanic waters, including the five named 'oceans' - the Atlantic, Pacific, Indian, Southern and Arctic Oceans - a connected body of salty water that covers over 70 percent of the Earth's surface.

This vast environment is home to a broader spectrum of higher animal taxa than exists on land. Many marine species have yet to be discovered and the number known to science is expanding annually. The sea also provides people with substantial supplies of food, mainly fish, shellfish and seaweed. It is a shared resource for us all.

Levels of anthropogenic marine noise have doubled in some areas of the world, every decade, for the past 60 years. (McDonald, Hildebrand *et al* 2006, Weilgart 2007) When considered in addition to the number other anthropogenic threats in the marine environment, noise can be a life-threatening trend for many marine species.

Marine wildlife rely on sound for its vital life functions, including communication, prey and predator detection, orientation and for sensing surroundings. (Hawkins and Popper 2014, Simmonds, Dolman *et al* 2014) While the ocean is certainly a sound-filled environment and many natural (or biological) sounds are very loud, wildlife is not adapted to anthropogenic noise.

The species groups covered in the following sub-modules are:

- Inshore Odontocetes
- Offshore Odontocetes
- Beaked Whales
- Mysticetes
- Pinnipeds
- Polar Bears
- Sirenians
- Marine and Sea Otters
- Marine Turtles
- Fin-fish
- Elasmobranchs
- Marine Invertebrates

General principles

Building on the information from module section B.1, sound waves move through a medium by transferring kinetic energy from one molecule to the next. Animals that are exposed to elevated or prolonged anthropogenic noise may experience passive resonance (particle motion) resulting in direct injury ranging from bruising to organ rupture and death (barotrauma). This damage can also include permanent or temporary auditory threshold shifts, compromising the animal's communication and ability to detect threats. Finally, noise can mask important natural sounds, such as the call of a mate, the sound made by prey or a predator.

Table 1: Potential results of sound exposure (from Hawkins and Popper 2016)

Impact	Effects on animal
Mortality	Death from damage sustained during sound exposure
Injury to tissues; disruption of physiology	Damage to body tissue, e.g internal haemorrhaging, disruption of gas-filled organs like the swim bladder, consequent damage to surrounding tissues
Damage to the auditory system	Rupture of accessory hearing organs, damage to hair cells, permanent threshold shift, temporary threshold shift
Masking	Masking of biologically important sounds including sounds from conspecifics
Behavioural changes	Interruption of normal activities including feeding, schooling, spawning, migration, and displacement from favoured areas
These effects will vary depending on the sound level and distance	

These mechanisms, as well as factors such as stress, distraction, confusion and panic, can affect reproduction, death and growth rates, in turn affecting the long-term welfare of the population. (Southall, Schusterman *et al*, 2000, Southall, Bowles *et al*, 2007, Clark,

Ellison *et al*, 2009, Popper *et al*, 2014, Hawkins and Popper 2016)

These impacts are experienced by a wide range of species including fish, crustaceans and cephalopods, pinnipeds (seals, sea lions and walrus), sirenians (dugong and manatee), sea turtles, the polar bear, marine otters and cetaceans (whales, dolphins and porpoises)–the most studied group of marine species when considering the impact of marine noise.

The current knowledge base is summarized in the following module.

This important volume of information should guide the assessment of Environmental Impact Assessment proposals.

References

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B.6. Polar Bears

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Consider when assessing

- Seismic surveys
- Civil high power sonar
- Coastal and offshore construction works
- Offshore platforms
- Playback and sound exposure experiments
- Pingers and other noise-generating activities

Related modules

- Refer also to modules B.1 and B.5 when assessing impact to polar bears

B.6.1. Species Vulnerabilities

There are two studies of polar bear hearing, showing that polar bears have hearing similar to humans, and that best sensitivity was shown between 11.2 – 22.5 kHz (Nachtigall *et al* 2007), and 8 – 14 kHz (Owen and Bowles 2011).

There have not been many specific studies of polar bears and noise. It has been shown that polar bears in Spitsbergen are disturbed by snowmobiles and can show strong behavioural reactions on a distance of 2-3 km, females with cubs showing stronger reactions at longer distance than adult males (Andersen and Aars 2008).

Polar bear would be highly vulnerable when hunting, as they are hunting for seals and depend on stealth, either by sneaking up on seals or by waiting at seal breathing holes in the ice (Stirling 1974, Stirling and Latour 1978). Studies indicate that denning females could be somewhat protected from noise from seismic air guns, although they could be vulnerable if sound sources are within close proximity of the den (less than 100 m) (Blix and Lentfer 1992).

B.6.2. Habitat Considerations

Polar bear's essential habitat is sea ice. Polar bears would prefer to stay on sea ice covering shallow and productive shelf areas (Durner *et al* 2009, Schliebe *et al* 2006). There would be particular concerns associated with all activities that have an impact in areas which resource selection functions have shown are preferred sea ice habitat for polar bears (Durner *et al* 2009).

Some models project an ice-free Arctic Basin in summer in just a few years from now, before 2020 (Maslowski *et al* 2012), and modelling studies have shown that most subpopulations will be reduced and experience large environmental stress (Amstrup *et al* 2008, Hamilton *et al* 2014).

Although not exclusively associated with specific habitats, there are certain activities that might be a concern. Some industrial activities are located in important habitat, of special concern is oil drilling activities on sea ice in productive sea areas, and the prospect of new developments of petroleum exploration in critical habitat, especially in North America. It must be noted that there are little or no specific studies of the effect of noise or manmade sound on polar bears, thus the level of impact is to a large degree inferred from general expert knowledge of the effect of disturbance on these animals.

Future impact from disturbance from sound exposure needs to be focused on denning areas in spring, and areas of sea ice and glacier fronts that are used by females with cubs-of-the-year to find food immediately after den emergence. Arctic areas in northern Canada, bordering to the Arctic Basin are generally the areas where one expects sea ice habitat to persist for the longest period (Amstrup *et al* 2007).

B.6.3. Impact of Exposure Levels

Given the specific vulnerability of polar bears to habitat loss, the exposure level of polar bears, especially in denning areas in spring, and areas of sea ice and glacier fronts that are used by females with cubs-of-the-year to find food immediately after den emergence should be prioritized.

B.6.4. Assessment Criteria

An assessment of the future impact of noise would have to take into account the dramatically decreasing area of critical sea ice habitat, in some areas the length of the ice-free period from ice melt in spring till ice freeze-up in fall, has increased by more than 140 days in the period 1979-2015 (Laidre *et al* 2015).

A minimum would be that EIAs on impact of sound would assess to what extent sound exposure would be detrimental to reproductive success by directly considering the effect of sound in denning areas and productive sea ice areas in the vicinity of denning areas, and also areas of sea ice over productive shelf areas.

References

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