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

Module B.8.

Marine and Sea Otters

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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Hawkins, AD. and Popper, A. 2014. 'Assessing the impacts of underwater sounds on fishes and other forms of marine life.' *Acoust Today* 10(2): 30-41.

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Southall, B Bowles, A. *et al* 2007. 'Marine mammal noise-exposure criteria: initial scientific recommendations.' *Bioacoustics* 17(1-3): 273-275.

Southall, B Schusterman, R. *et al* 2000. 'Masking in three pinnipeds: Underwater, low-frequency critical ratios.' *The Journal of the Acoustical Society of America* 108(3): 1322-1326.

Weilgart, L. 2007. 'The impacts of anthropogenic ocean noise on cetaceans and implications for management.' *Canadian Journal of Zoology* 85(11): 1091-1116.

B.8. Marine and Sea Otters

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Consider when assessing

- Seismic surveys
- Civil high power sonar
- Coastal and offshore construction works
- Playback and sound exposure experiments
- Vessel traffic greater than 100 metric tons
- Vessel traffic less than 100 metric tons
- Pingers and other noise-generating activities

Related modules

- Refer also to modules B.10, B.12 and C when assessing impact to marine and sea otters

B.8.1. Species Vulnerabilities

The marine otter, *Lontra feline,* and sea otter, *Enhydra lutris,* are amphibious marine mammals that may be vulnerable to coastal anthropogenic disturbance. Auditory thresholds for sea otters have been measured in air and underwater from 125 Hz to 40 kHz. Critical ratios data indicate that although sea otters can detect underwater sounds, their hearing appears to be primarily air adapted and not specialized for detecting signals in background noise. (Ghoul and Reichmuth 2012, 2014, 2016)

B.8.2. Habitat Considerations

There is little definitive research available about the specific anthropogenic noise vulnerabilities of this species group, but given the frequency range of hearing and the knowledge that these animals are social communicators and benthic foragers, (McShane *et al*, 1995, Leuchtenberger *et al*, 2014, Lemasson *et al*, 2014, Thometz *et al*, 2015) this species group should be considered. Their dependence on restricted nearshore habitats puts sea otters at risk from acoustic disturbance and activities occurring both on land and at sea. (Ghoul and Reichmuth 2016)

B.8.3. Impact of Exposure Levels

Ghoul and Reichmuth (2016) have conducted the only known assessment of sea otter hearing sensitivity. They found that hearing was most sensitive at 8 and 16 kHz, where measured thresholds were the lowest at 69 dB re 1 µPa. The range of best sensitivity in water spanned ~4.5 octaves, from 4 to 22.6 kHz. The roll-off in high-frequency hearing was typically steep and had a 28-dB increase within a half-octave frequency step. Low-frequency hearing (0.125–1 kHz) was notably poor. The sea otter was unable to detect signals below 100 dB re 1 µPa within this frequency range. Noise spectral density levels in the underwater testing enclosure were sufficiently low to ensure that the measured thresholds were not influenced by background noise, especially at frequencies above 0.5 kHz, where noise levels were below 60 dB re 1 µPa/√Hz. (Ghoul and Reichmuth 2016)

B.8.4. Assessment Criteria

Regulators estimating zones of auditory masking for sea otters should follow the guidance given for other marine mammals and opt for conservative estimates until additional data are available. (Southall *et al*, 2000)

B.8.5. Species not listed on the CMS Appendices that should also be considered during assessments

Sea otters, *Enhydra lutris*, are classified by IUCN as Endangered, and should also be considered during assessments.

References

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McShane, LJ Estes, JA Riedman, ML. and Staedler, MM. 1995. Repertoire, structure, and individual variation of vocalizations in the sea otter. *Journal of Mammalogy*. 76, 2: 414-27.

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