

Working Group I: Impacts on Marine Animals

Report by Darlene R. Ketten¹

MEMBERS OF WORKING GROUP I:

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WORKING GROUP CHARGE

Working Group I took as its mandate to review the known effects of noise, to determine from those areas of concern, and to recommend needs for additional data required for developing exposure guidelines. All statements included were reached by consensus except in those cases where a minority comment is included immediately following the relevant majority statement.

BIOLOGICAL SCOPE OF CONCERN

The working group concluded that effectively all taxa present in the Antarctic are potentially impacted, and therefore our concerns should be directed not only at marine mammals, but equally at birds, fish, and invertebrates. Both direct impacts on each taxa and indirect effects through behavioural and ecological interdependencies are important to consider.

POTENTIAL IMPACTS: ACOUSTIC SOURCES

We recognize that there is insufficient data to provide definitive guidelines for exposure limits that are safe for any or all sources at both the individual and population level. We also recognize that it is necessary nevertheless to provide some basis for responsible regulation of anthropogenic activities in the Antarctic.

Consequently we recommend a risk reduction approach be adopted based on the best available information at this time in order to reduce potential hazards to marine animals and degradation of Antarctic ecosystems.

Minority Comment

The absence of observable short-term reactions to noise does not prove that no severe, long-term population effects are present.

KEY ISSUES

The following three issues should be considered in assessing the available data and developing conservative guidelines to minimize risk :

- 1) The first key issue is that not all acoustic exposures may be biologically significant. Differentiation of significant and insignificant effects should take into consideration prior assessments of this issue.

Some countries that are signatories to the Madrid Protocol have previously considered how to determine significance, and it is recommended that their approaches and conclusions be considered as well as those from recent relevant meetings; e.g., SCAR (Kiel 1998, Cambridge 2001).

Implicit in the risk reduction concept is the need in the decision-making process to perform cost-benefit analyses that include the scientific significance of any proposed project and its integration with existing research as determined by scientific review.

Following Madrid Protocol Annex I, potential impacts were divided into insignificant and significant. We note the following concerns.

Insignificant: less than minor and transitory

Some exposures to an individual animal are of such a short duration, low intensity, and non-repetitive that no significant physiological or behavioural impact will occur. The limits for exposures that are insignificant are context and species-specific. Further, a key issue is to determine what number of individuals impacted represent a significant impact.

Significant

Acoustically, sound exposure to the animal is the critical element in determining impact from a sound source. Therefore, it is imperative to know the source and propagation characteristics. Important source characteristics include frequency, source level, waveform, pulse duration, inter-pulse interval, and beam properties.

In addition to standard propagation phenomena, an important issue for the Antarctic includes the potential for a larger radius of effect because of the occurrence of upward refracting conditions.

Lastly, to accurately determine or estimate sound exposure impact, we need not only to consider the source but also the animal as a receiver. A fundamentally important characteristic to consider is the hearing ability of each

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species potentially exposed. In addition, at the individual level, the movement patterns of both the source and the animal need to be considered. Further, there may be non-auditory physiological effects to the animal from sound exposures. At this point, it is unclear that significant non-auditory physiological effects occur except from intense exposures but too little is known about such effects to say definitively how important they may be.

- 2) For behavioural questions in particular, a key issue is to determine how impacting the well-being of an individual ultimately relates to welfare of the population.
- 3) Lastly, distribution of the animals is an important component for estimating their probable exposures.

Typically, animals are patchily distributed, therefore average density for large areas may not accurately represent potential impact for populations that tend to clumping. It needs to be acknowledged that average density is a crude estimate that should be tempered with regional information where available.

Minority Comment

Average density for large areas is unlikely to accurately represent potential impact for populations that tend to clumping.

IMPACT TYPES: IMMEDIATE AND CUMULATIVE

The following outline indicates the major impact categories that are important to monitor and to investigate due to the paucity of marine-based data. Clearly some of these overlap in their effects or impacts, but the principal divisions are as follows:

Auditory

- Threshold Changes,
- Permanent (PTS),
- Temporary (TTS),
- Masking,

Other Physiological Damage

- Stress,

Behavioural Effects

- Aversive,
- Attractive,
- Disruptive,

Ecological

- Habitat disruption,
- Displacement,
- Predator-prey effects.

RECOMMENDATIONS

Researchers and organizations proposing work in the Antarctic should consult with biologists with appropriate experience to assess potential impacts prior to formal permit application.

DATA GAPS

For the majority of marine species present in the Antarctic, there are insufficient auditory, behavioural, population, and ecological data for definitive guidelines. This is arguably the most important issue. Except where noted, the needs apply to all taxa. Salient gaps include the following:

Auditory

- Marine Mammals,
- Audiograms (hearing range and sensitivity) for mysticetes and pinnipeds,
- TTS for all species for impulse, repeated, and continuous signals,
- PTS on any species,
- Birds,
- Audiograms for penguins and cormorants,

Physiological

- Stress measures, including but not limited to cardiac and hormonal stress indicators,

Behavioural

- Underwater responses to sounds,

Population/Ecological

- Population dynamics of marine mammals and prey