

A Workshop on Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals: From Ideas to Action

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ABSTRACT

As part of their ongoing work on the impacts of anthropogenic noise on marine mammals, Okeanos – Stiftung für das Meer will be holding a multi-disciplinary Workshop on Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals: From Ideas to Action in Monterey, California, in August 2009. Participants at the three-and-a-half-day workshop will include biologists, acousticians, modellers, managers, an environmental economist and a network physicist, as well as other specialists in assessing cumulative and/or synergistic impacts. Early discussions will focus on a generalised process for managing cumulative impacts (particularly from noise, as this has not been included in many, if any, cumulative exposure assessments) within any marine mammal population. We will then breakout into three groups focusing on additive and synergistic impacts on an individual level; integration of cumulative impacts assessments at the demographically independent population level; and ecosystem-based management of cumulative impacts. The overarching goal of the workshop will be to develop, to the extent possible, a practical process for estimating how cumulative impacts from anthropogenic activities are impacting marine mammals and their populations. The workshop aims to do this by exploring the applicability of methods used in cumulative impacts assessments carried out in other environments, determining how best to include noise in total stressor exposure assessments, models and maps, and exploring ways to incorporate the potential synergism of different anthropogenic stressors into management decisions. Participants will also attempt to identify the appropriate level (i.e., individual, population, ecosystem) for achieving the most efficient management of cumulative impacts.

Keywords: management procedure, noise, climate change, pollutants, stress, modelling

BACKGROUND

Okeanos – Stiftung für das Meer (Foundation for the Sea) and affiliate Dokumente des Meeres have been undertaking projects on marine mammals and noise since they were established. Dokumente des Meeres seeks to bring the issue to the attention of the public through a feature-length documentary, while Okeanos has been supporting this effort through addressing knowledge gaps in the science and policy on the issue by sponsoring both research and workshop discussions. After the initial success of the Global Scientific Workshop on Spatio-Temporal Management of Noise on a Regional Scale and the multi-disciplinary Workshop on Noise-Related Stress in Marine Mammals, both held in Lanzarote in June 2007, Okeanos moved to address shipping specifically in April 2008, by hosting a Workshop on Noise from Shipping Operations and Marine Life: Technical, Operational and Economic Aspects of Noise Reduction. This was again successful and inspired the U.S. submission to the International Maritime Organisation for the establishment of a Correspondence Group, under the prevue of their Marine Environmental Protection Committee, to consider voluntary guidelines to reduce low-frequency noise from ships.

Okeanos will be holding two more workshops later this year – a multi-disciplinary Workshop on Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals: From Ideas to Action, followed by a Workshop on Alternative Technologies to Seismic Airgun Surveys for Oil and Gas Exploration and their Potential for Reducing Impacts on Marine Mammals in Monterey, California, in August and September 2009. Responding to the widespread interest expressed with regards to the issue of cumulative impact assessment

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and management in marine mammals in general, we (Okeanos) offer this summary of our intended efforts and welcome any comments of suggestions that the members of the International Whaling Commission Scientific Committee might have. Please recognise that this is, and will continue to be, a work in progress and specific details and plans may change prior to the meeting.

WORKSHOP AGENDA AND GOALS

The cumulative impacts¹ of ocean noise and other anthropogenic stressors on cetaceans and other marine mammals are difficult to quantify and often thus receive little more than a cursory mention in assessments of environmental impacts. This means they are not truly incorporated into most management decisions. A recent US National Research Council (NRC) report acknowledged the difficulty inherent in moving from observed non-lethal responses to noise by individuals to population-level impacts, and noted that marine mammal scientists and managers are at least a decade away from obtaining enough data to make such estimates (NRC, 2005). From a management standpoint, however, there is a clear and pressing need for practical frameworks and methodology that managers can use immediately to address these various possible impacts, despite the large uncertainties. This may require the consideration of alternative methods for determining management action with limited data. Utilizing the available information on population-growth-negative impacts² and their ultimate consequences for individuals and populations, workshop participants will be asked to explore various approaches to quantifying the consequences of cumulative exposure to one or more stressors, such as noise, human disturbance, climate change, chemical pollution, habitat modification, and disease, on marine mammal populations. The overarching goal of the workshop will be to develop, to the extent possible, a practical process for estimating how cumulative impacts from anthropogenic activities are affecting marine mammals and their populations. Participants at the three-and-a-half-day workshop will include biologists, acousticians, modellers, managers, an environmental economist and a network physicist, as well as other specialists in assessing cumulative and/or synergistic impacts.

Key aims of workshop

- To explore ways in which cumulative impacts assessments have been carried out in other environments or for other species and evaluate their applicability to marine mammal populations, with the ultimate goal of developing a practical methodology for managing these impacts, with or without full understanding of their extent.
- To determine how best to include noise in total stressor exposure assessments, models and maps.
- To explore ways to incorporate the potential synergism of different anthropogenic stressors, such as noise, human disturbance, chemical pollution, climate change, habitat modification, and disease, into management decisions.
- To consider and identify the appropriate biological level (i.e., individual, population, ecosystem) and suitable legal tools for achieving the most efficient management of cumulative and synergistic impacts on marine mammals.

WORKSHOP OUTLINE

Presentations

Participants will be asked to present appropriate material from their areas of expertise in four sessions over the first day and a half. These sessions will be:

¹ For the purposes of the workshop, “cumulative impacts” may be lethal, or they may be sub-lethal and/or non-lethal, impacts on individuals from anthropogenic activities, which may lead to population-level effects when taken in aggregate. These impacts may come from a single source (e.g., noise), or from multiple sources or stressors.

² Any impacts are those that negatively alters birth and/or death rates (exclusion from prime feeding areas, social disruption, etc.).

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- Session 1 – Biology: A review of available information on impacts of noise on marine mammals, stressor interactions in general, and the potential mechanisms for direct/indirect cumulative and synergistic impacts.
- Session 2 – Mathematics: A review of the various models, risk assessments, frameworks and other mathematical and conceptual ways to assess cumulative impacts, including from environmental economic and network theory.
- Session 3 – Regulatory Standards: A brief review of current requirements, standards and practices in the U.S., Europe and elsewhere regarding cumulative impacts and potential legislation for their appropriate management.
- Session 4 – Cumulative Impacts Assessments (CIAs): A review of current efforts to assess cumulative and synergistic impacts in both the marine and terrestrial environments, as well as consideration of future directions.

Whole group discussion 1: Marine mammals, noise and CIAs

Drawing from the information and examples in the presentations, participants will be asked to discuss the options for a generalised process for managing, to the extent possible, cumulative and synergistic impacts (including from noise) within any marine mammal population. Participants will consider the most suitable means of achieving this scientifically, without (at this point) concern for the available legal mechanisms and frameworks. Realising that the goal of quantitatively assessing cumulative impacts may be, at present, unachievable, we anticipate that this discussion will focus around qualitatively assessing cumulative exposures. The need for management decisions despite only extremely limited data available will need to be considered, while participants should also remain mindful of possible ways to integrate synergistic effects into any models or assessments.

Available methodology and management practices that could be adapted to involve cumulative impacts include, but are not limited to: risk assessment models; dose-response analyses; Bayesian population modelling; population viability assessments (PVAs); the U.S. Potential for Biological Removal (PBR) system; the framework outlined in the IWC's Habitat Degradation Workshop report (see Fig 3, SC/57/Rep2), stressor-combination models, the concept of allostasis, the NRC (2005) Population Consequences of Acoustic Disturbance (PCAD) model, energy budget calculations, etc. It is anticipated that this discussion will frame questions and tasks to be given to the various breakout groups for their specific consideration under their wider goals (below).

Breakout group 1: Additive vs. synergistic impacts on an individual level

Participants involved in this discussion will be asked to consider the various options for including synergistic impacts within CIAs. Recognising the individual as the most often regulated unit in laws specifically protecting marine mammals and that cumulative impacts from multiple stressors can be additive, synergistic, or antagonistic, we anticipate this discussion beginning with the creation of a qualitative or conceptual decision-tree for when synergistic impacts are likely to occur for individuals (possibly resulting in some ranking scheme). Participants shall then be asked to identify ways to incorporate these into currently available cumulative exposure models and/or the proposed mechanisms from Whole group discussion 1.

Breakout group 2: Population level integration

Recognising the demographically independent population level as the scientifically most appropriate unit for species-based conservation, participants in this discussion will be asked to consider ways to integrate cumulative and synergistic impacts at this level. It is anticipated that geographic-temporal variation in overlaps between stressors and different life-cycle stages will feature heavily in this discussion. Given that data are often limited, participants will be asked to consider possible ranking schemes and/or simplified scales for estimating additive/synergistic impacts at the population level. Participants could identify a set of basic criteria for use across a broad range of threats to assess their relative level of impact on various marine mammal populations. Criteria that have previously been used to assess impacts on ecosystems include: spatial scale, taxonomic scale (species to whole communities), frequency of activity, resistance of ecosystem, and recovery time of ecosystem. The application of PVAs and other models to the determination of the effectiveness of any management action should also be discussed, time permitting.

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Breakout group 3: Ecosystem-based management of cumulative impacts

Participants in this discussion will consider management of cumulative impacts in the widest sense, recognising that many stressors affect multiple elements of any ecosystem in various ways, both directly and indirectly. Regardless of current legal frameworks, participants will be asked to consider these various mechanisms of effect and identify ways to assess their overall impact on the ecosystem as a whole, as well as ways to determine and/or measure effectiveness of any efforts to reduce such impacts. It is anticipated that this discussion will focus on the integration of noise into current efforts to model cumulative stressor exposure. Participants will only then consider appropriate legal mechanisms for the application of the techniques identified.

Whole group discussion 2: Summary of breakout groups

Each Breakout Group will present a brief summary of their discussions, findings and conclusions. A discussion of how the various conclusions can be integrated will follow, once all the presentations have been made.

Whole group discussion 3: The way forward

In this discussion participants will attempt to combine the work of the Breakout Groups to produce a process through which managers can begin to effectively consider cumulative and synergistic impacts in their assessments and thus improve the information upon which they base their decisions. Participants will then outline available legal mechanisms (from the U.S. and Europe) for achieving effective management action and detail any legislative changes or research deemed necessary. To allow for application of any conclusions and/or frameworks beyond the U.S. and European focus, participants will also be asked to provide some more general advice for managers in other countries or regions that may also be attempting to consider impacts of noise or other stressors upon marine mammals (or other species) in their management decisions. With this in mind, participants may consider the opening Arctic, which will require international management that will likely have regulatory elements based upon current legislation in the U.S., Europe, Canada and Russia.

PRODUCT(S)

The discussions that occur in this workshop will be compiled into a report discussing the various approaches to estimating and assessing cumulative impacts, with the goal of culminating in a proposed framework/methodology for effective assessment of cumulative and synergistic impacts. Recommendations for incorporating such cumulative impacts into existing management frameworks will also be provided. If possible, a short paper may be crafted for wider, peer-reviewed discrimination of the conclusions in Conservation Biology, or similar.

REFERENCES

NRC (US National Research Council). 2005. *Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects*. The National Academies Press, Washington, D.C. 126 pp.

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