MARINE ENVIRONMENT PROTECTION COMMITTEE
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Agenda item 19

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WORK PROGRAMME OF THE COMMITTEE AND SUBSIDARY BODIES

Information on Noise from Commercial Shipping Operations and Marine Life

Submitted by Australia

SUMMARY

Executive summary:	This document provides information on the levels of shipping noise in the marine environment, particularly in Australia and Antarctic oceans. It also gives a brief summary of some ship design elements that can assist in minimizing the introduction of noise into the marine environment.
Strategic direction:	1, 7 and 13
1High-level action:	1.1.2
Planned output:	1.1.2.3
Action to be taken:	Paragraph 21
Related document:	MEPC 58/19

Introduction

1 In document MEPC 58/19, the United States proposes the addition of a new high priority work item on the MEPC agenda to identify and address ways to minimize the introduction of incidental noise into the marine environment by commercial shipping to reduce the potential adverse impact on marine life. The proposal is to develop non-mandatory technical guidelines for ship-quieting technologies as well as potential navigation and operational practices.

2 Australia considers that the potential adverse impact on marine life from noise produced by commercial shipping warrants action by IMO, and supports the work programme item proposal and the approach suggested by the United States.

3 This document presents information on recent research in Australia and the Southern Ocean which may be of assistance to the Committee in its deliberations. The purpose of presenting this information is to provide a perspective based on research in Australian and Antarctic oceans where shipping densities are generally lower than in the European and North American waters. In developing internationally relevant guidelines, MEPC will need to recognize the large spatial variations in shipping noise and understand the processes that cause these variations.

4 This paper also provides some information on aspects of ship design which can help to mitigate the generation of underwater noise from ships, and considers specific shipping activities that contribute to underwater noise.

The benefits of studying low traffic areas

5 According to Cato & McCauley (2002)[1], ocean noise dependence on position and time is so complex that there is little point trying to 'map' ambient noise from point observations. Instead, the processes that generate ocean noise must be understood. Ambient noise in Australian waters is substantially different to that in waters around North America and Europe. Lower levels of shipping traffic noise near Australia and a substantial focus on shallow, tropical waters have allowed the study of aspects of natural noise including rain, wind and biological noise (Cato & McCauley, 2002).

6 In Australian waters, traffic noise varies by as much as 20 decibels with different shipping densities and underwater sound propagation conditions. The wide variation in traffic noise levels in Australia may be more representative of much of the world's oceans, than North American and European datasets (Cato, 2000)[2].

7 In northern waters, the wind component has not been discernible from traffic noise, because there are no characteristics of wind noise that can be used to distinguish it from traffic noise (Cato & McCauley, 2002). Biological noise (generated by marine mammals, fish and invertebrates) has also not featured strongly in northern hemisphere ambient noise prediction models, but Australian research has shown that, at least in Australian waters, that this component is of vital importance to a full understanding of ocean noise (Cato & McCauley, 2002).

8 At the request of the Antarctic Treaty Consultative Meeting XXIII in 2000, marine acoustics in the Southern Ocean have been under review by the Scientific Committee on Antarctic Research (SCAR) which most recently reported to ATCM XXIX in 2006 (SCAR, 2006)[3]. In the absence of high shipping densities, the Southern Ocean provides an opportunity to study natural ocean noise as well as the risk of introducing anthropogenic noise.

9 There are many low frequency natural sounds in the Southern Ocean which can travel long distances, including continuous wave noise, the breaking and movement of sea ice, calving of sea ice, and icebergs dragging on the sea floor (SCAR, 2006). Like the sounds from commercial ships, these noises can travel great distances and contribute to ambient noise in ocean basins. In addition, seismic noise in the Southern Ocean emanates from tectonic plate movements and underwater volcanic activity around the South Sandwich Trench (SCAR, 2006).

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1 Cato, D.H. & McCauley, R.D. (2002) Australian research in ambient sea noise. *Acoustics Australia*, April 2002, pp1-13.

2 Cato, D.H. (2000) Ocean noise and the use of sound by marine mammals. *Proceedings of the Acoustics 2000 Conference, Joondalup Resort, Western Australia, 15-17 November 2000.*

3 SCAR (2006) SCAR Report on marine acoustics and the Southern Ocean. ATCM XXIX WP41.

Implications of natural ocean noise for understanding the impact of ambient noise from shipping

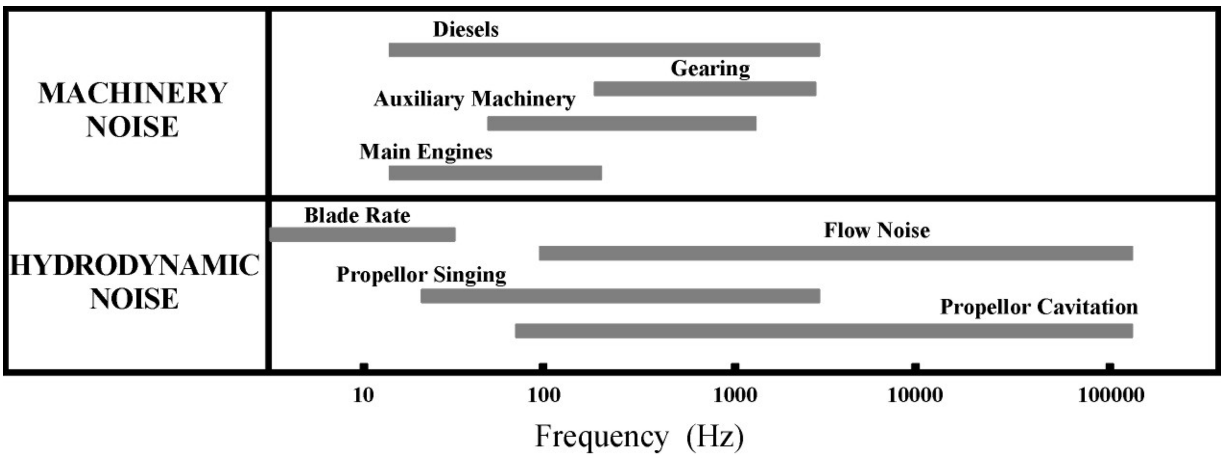
10 Low frequency wind-dependent noise is the dominant prevailing component of ambient noise at frequencies below 200Hz in the Australian region. Winds of 15-20m/s generate sea conditions leading to underwater noise that is comparable to the high levels of traffic noise in North American waters. For a significant proportion of time, wind-dependent noise is at similar levels to shipping traffic noise (Cato, 2000)[4].

11 Wind and biological noise add significantly to ambient noise at low frequencies, and this suggests that marine animals have always been subject to noise levels that are often comparable to moderate or high levels of traffic noise (Cato, 2000). Since there is no acoustical distinction between the traffic and wind-dependent noise, both sources are limiting to the use of sound by marine life (Cato, 2000). Natural variations in ambient noise over the range between 10Hz and 20kHz is about 20dB, with extremes of 30dB. This variation is typical and common, so marine animals must cope with regular variation in the distance over which their use of sound is effective.

12 It has been supposed on the basis of data from high shipping densities that there was once a 'noise notch' of low frequencies that were exploited by whales, but is no longer available due to traffic noise. However, a consideration of the wind and other natural noise sources indicates that the contribution of shipping to ambient noise in high traffic areas has actually been to remove the 'quiet times' when wind and biological noise is low (Cato, 2000; Cato, in press[5]).

Types and control of ship-sourced noise

13 Ships generate underwater noise over a broad range of frequencies, from <10Hz to >100kHz as represented in the diagram below (Source: Norwood)[6].



14 If a vessel is to meet specified noise requirements, then these requirements need to be clearly defined and incorporated during the design phase, as retro-fitting noise control treatments can cost two to three times what it would have cost during construction, as well as taking additional installation time and adding weight to the vessel (Norwood).

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4 Cato, D.H. (2000) Ocean noise and the use of sound by marine mammals. *Proceedings of the Acoustics 2000 Conference, Joondalup Resort, Western Australia, 15-17 November 2000.*

5 Cato, D.H. (in press) The effects of noise on aquatic life.

6 Norwood, C. (not dated) *Noise from vessels and its control.* Teaching materials, Defence Science and Technology Organization, Australia.

15 There are a number of design elements that are known to reduce the generation and transmission of noise by a vessel. For example, measures that may be incorporated into machinery design include resilient mounting of equipment with flexible pipe couplings, optimization of machinery frequencies in comparison with the natural frequencies of mountings and connections, effective balancing of machinery, design and quality of bearings, optimization of tooth pitch and helix angle in gearing, and precision in gear fabrication. Pumps can be chosen and designed to closely match flow requirements as they are generally quietest when working at or near design point. Electrical equipment can be dynamically balanced, designed with quieter cooling fans and optimized in terms of flux densities and machine speed (Norwood).

16 The hull design is also important in controlling noise, particularly through the reduction of turbulence – elliptical bow shape, no abrupt changes of shape in the waterline, minimization and alignment with flow of appendages and fittings, flush welds, undistorted plates and smooth paintwork (Norwood).

17 Propeller cavitation is the formation then collapse of water vapour bubbles as water moves across a propeller blade. If propeller cavitation occurs, it will be the dominant noise source and increases noise levels by about 20dB in the 80Hz to 100kHz band. While all propellers will cavitate if sufficiently loaded, cavitation can be avoided under normal operating conditions through good design – optimizing load, ensuring uniform water flow into propellers which can be influenced by hull design), and careful selection of propeller size and blade section, pitch and camber (Norwood).

18 Propellers can also ‘sing’ when the frequency the turbulence created by the propeller matches the natural frequency of the propeller itself. The resonance produced results in the emission of an intense tone, which can cause hull vibration and transmission of the sound within the vessel and through the water (Norwood).

19 Finally, specific shipping activities can generate underwater noise. For example, ice-breaking ships introduce continuous, loud noise, and this continuous noise can produce a temporary change in an animal’s auditory sensitivity (“Temporary Threshold Shift” or TTS) at lower levels than pulsed sound (SCAR, 2006). Shipping in the Southern Ocean includes supply ships, tourist, fishing, research and military vessels. These operations, although relatively infrequent, are more common during the summer months, and also tend to be concentrated on particular localities. Tourist vessels, in particular, focus on wildlife so activities are often conducted near wildlife breeding sites (SCAR, 2006). Coordination and management of the intensity of tourist activities in sensitive areas could take into account noise impacts from icebreaking and other incidental ship-sourced noise.

Recommendation

20 Australia welcomes the proposal for a new work programme item on minimizing the introduction of incidental noise from commercial shipping operations into the marine environment to reduce potential adverse impacts on marine life.

Action requested of the Committee

21 The Committee is invited to consider the information presented in this document in its further deliberations on this issue.

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