

Underwater Noise and Marine Wildlife: Current and Future Implication and Assessment

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Overview

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Introduction



- Underwater noise from anthropogenic sources have recently become an important consideration for the marine industry
- Impacts on marine environments and fauna are of concern, both in industrialised and newly explored areas
- IMO is addressing the subject and recently released guidelines for designers on addressing and reducing underwater noise
- Previously underwater noise from vessels has only been considered by Defence and Fisheries Research Vessels



Risks to Marine Fauna

- Exact short- and long- term effects on individuals and populations are not well understood, and much more research is required in this field
- Increased stress on the individuals can occur due to constant increases in ambient noise levels
- Avoidance of biologically significant areas and routes can occur, usually only while the sources if active, but in some cases for months or even years
- Masking of biologically important sounds is a key concern from shipping noise
- Behavioural changes and effects such as different diving, breeding and feeding patterns can be observed as a reaction in most marine fauna species
- In extreme cases, temporary and permanent threshold shift in hearing ability can occur

Current Regulatory Landscape

- ICES Limit for Fisheries Research Vessels
- EU Marine Strategy Framework Directive (MSFD)
- United Nations Convention of the Laws of the Sea (UNCLOS)
Art. 211
- 1992 Council Directive 92/43/EEC, on the Conservation of
Natural Habitats and Wild Flora and Fauna
- Marine Protected Areas (MPA's)



Impact Assessment Needs

- Limited guidelines and approaches currently available for naval architects and ship owners for assessing vessel
- Need to assess general acoustic performance of vessel in comparison to others
- Need to assess potential impact of vessel on marine wildlife
- Methods need to be easily implemented, and applicable during design stages and operation

Impact Assessment Approaches

- Three different approaches proposed for impact assessment
 - Biologically-based assessment
 - Rules-based assessment
 - Goals-based assessment



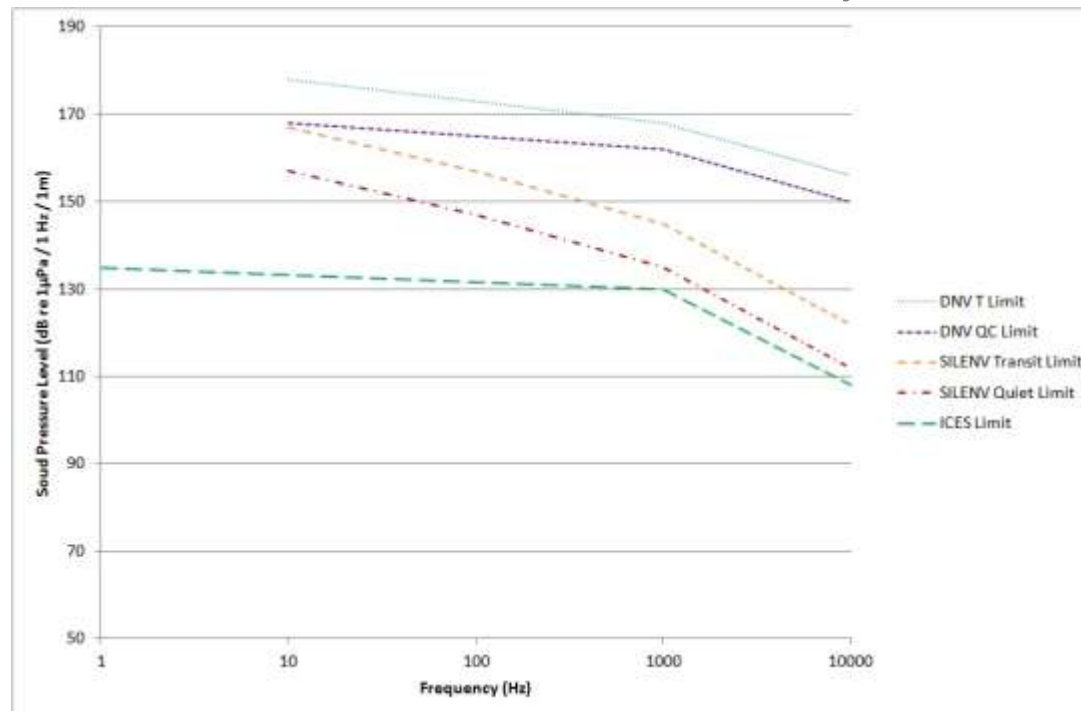
Biologically-Based Assessment

- Based on the use of threshold values for different types of impact in different marine wildlife species. Threshold limits proposed by the US National Marine Fisheries Service (NMFS) have been considered

Threshold Type	Limit (dB re 1 μ Pa)
Behavioural Changes	120
TTS in Cetaceans	224
TTS in Pinnipeds	212
PTS in Cetaceans	230
PTS in Pinnipeds	218

Rules-Based Assessment

- Based on the use of ICES, DNV and FP7 Project SILENV proposed limits



Goals-Based Assessment

- Wealth of information available in literature regarding:
 - hearing frequency ranges
 - vocalisation frequency ranges
 - habitats
 - conservation status
 - observed or measured reactions to different noise sources
- Use database of information for given ship operational area to find species likely to be impacted
- Use species data to assess most at risk and potential impacts

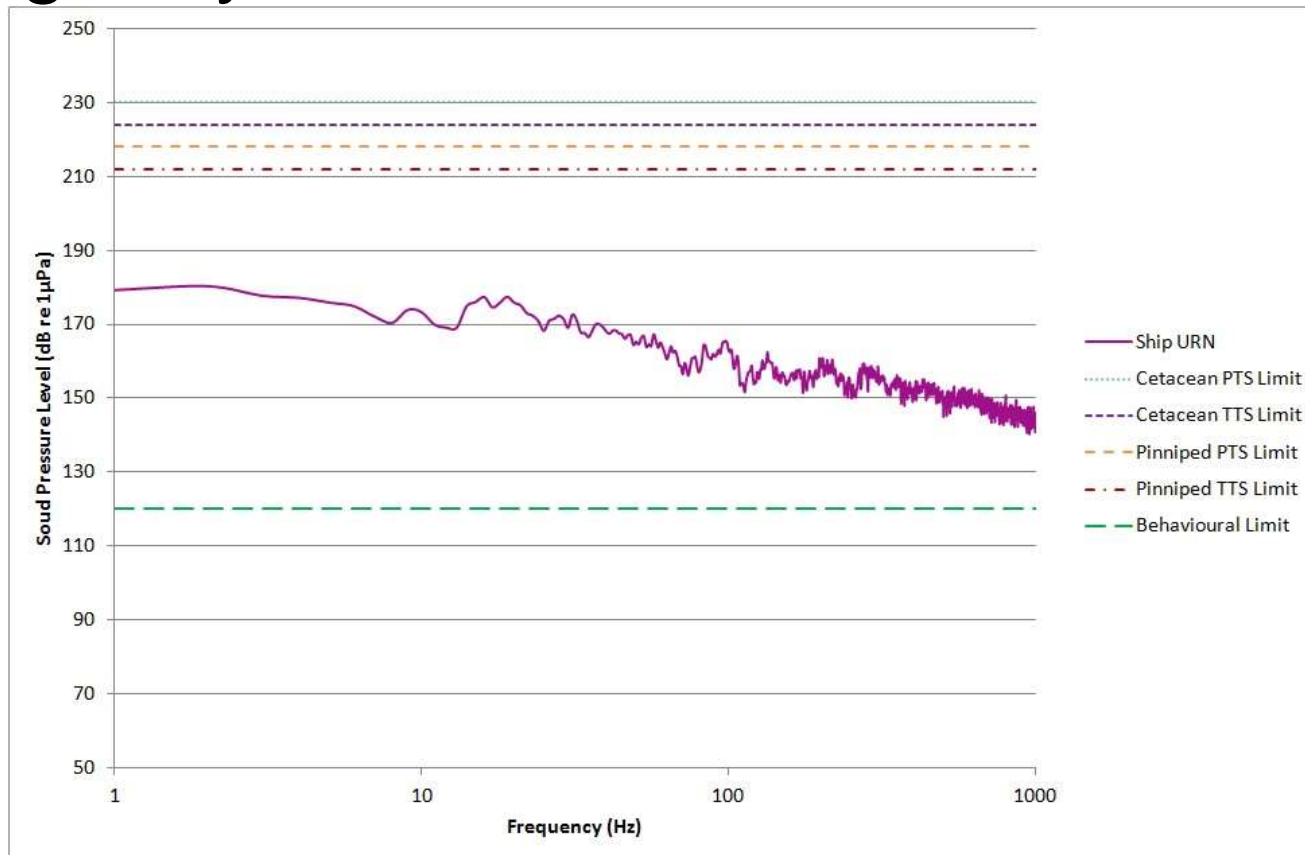
Case Study Example

- Assumed operational area is Mediterranean Sea
- Vessel is assumed to be commercial ship operating at 19 knots
- Database of wildlife information filtered for specified operational area
- Approximately 18 species identified in the area
- At risk species assumed to be those with Conservation Status of “Vulnerable”, “Endangered” or “Critically Endangered”

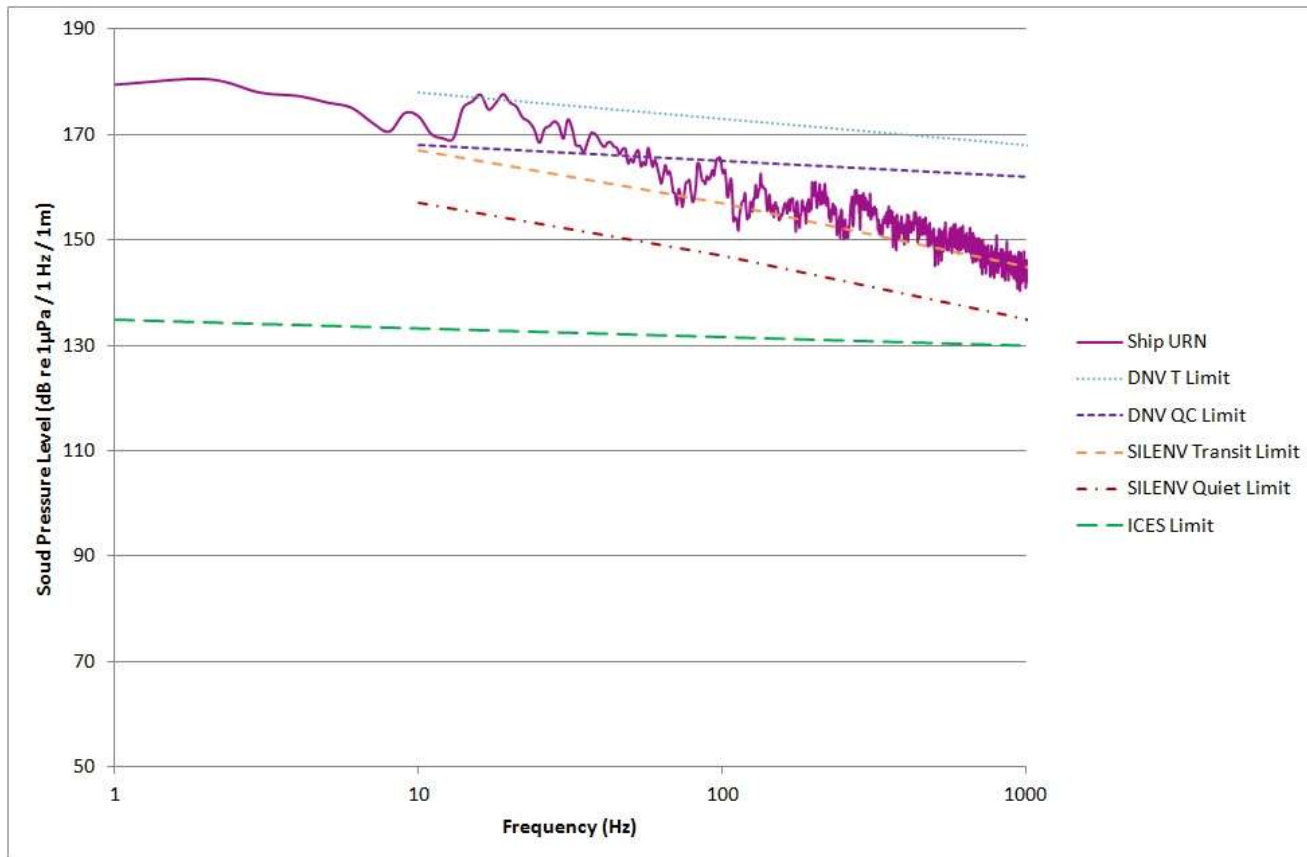
Assumed At Risk Species

Species	Hearing Range (Hz)	Vocalisation Range (Hz)	Observations
Atlantic Bluefin Tuna	50-1100	N/A	Changes to swimming and schooling behaviors at 135dB in reaction to ferries
Fin Whale	14-1000	10-28000	Behavioral effects at 15-100Hz, dives or faster swimming at around 1km distance, masking effects of social calls at low frequencies
Great White Shark	10-100	N/A	None Published
Green Turtle	Unknown	Unknown	None Published
Mediterranean Monk Seal	2000-40000	Unknown	None Published
Sperm Whale	100-20000	100-20000	Reactions can be variable, and include changing direction, shallower dives, avoidance at up to 2km and changes in breathing patterns

Biologically-Based Assessment



Rules-Based Assessment



Potential Future Regulation



- Likely to see more formal regulation in the future
- Greater use of Marine Protected Areas (MPA's) for local regulation
- Standardisation of prediction, measurement and report of ship noise
- Standardisation of data gathering and reporting for marine wildlife responses to and impacts from underwater noise



Closing Remarks

- Further research is required into understanding the impacts of underwater noise on marine fauna globally
- Further work is also required in developing methods for assessing the acoustic performance of vessels
- Requires inter-disciplinary collaboration and further education within the industry



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