

Abstract

In some countries the evaluations of the effects of piling noise on marine mammals are rather general. The use of standardized criteria on acceptable construction noise levels means that all projects will be subject to considerable expenses for noise mitigation.

In Germany offshore wind farms (OWF) are met with a requirement of not exceeding a noise level of 160 dB SEL for a single piling strike at a distance of 750 m from the piling site. The purpose of this criteria is to prevent temporary threshold shifts (TTS) in individual harbour porpoises. This criteria means that piling activity without noise mitigation is not possible.



Such standard requirements might result in a public perception that failing to meet the requirements will always and at all sites result in detrimental effects on marine mammals.

This again may result in the employment of expensive noise mitigation measures such as bubble curtains, hydro sound dampers etc. in situations where it is not really needed.

Information on animal density in the project area is included as well as information on the size of the subpopulation, that the animals are likely to be a part of, and the distribution area of the subpopulation.

Combining this information with a site specific noise model, information on the duration of the piling period and a number of other factors it is possible to determine a site specific noise criteria. The criteria might be greater or smaller than for instance the German criteria.

The advantage of the site specific method is for instance that a site with a very low density of marine mammals is not assessed in the same way as areas with higher densities. Or that a site with a high sound propagation loss due to e.g. a favourable depth profile or sediment conditions is not assessed in the same way as a site with a low sound propagation loss.

Results

In the table below information on sound propagation loss and presence of harbour porpoise at three possible future OWFs at Vesterhav Nord, Vesterhav Syd and Bornholm is presented.

Offshore wind farm	Sound propagation scenario	Sound propagation parameters		Porpoise density in the OWF area	Porpoise population size
		X	α		
Bornholm	Worst-case	13.8	0.001200	0.01	40,475
	Average	14.4	0.001350		
Vesterhav Nord	Worst-case	14.2	0.000800	0.45	230,000
	Average	14.6	0.000950		
Vesterhav Syd	Worst-case	13.9	0.000750	0.67	230,000
	Average	14.5	0.000750		

It is evident from the table that sound propagation loss at these three possible OWFs is rather similar. There are small differences, but there are other areas where much higher sound propagation loss is known. Apparently, differences in sound propagation loss does not seem to justify major differences in noise requirements at these three OWFs.

However there are notably differences in porpoise presence. The density of porpoise at Bornholm is much lower than at Vesterhav Nord and Syd. Even though the porpoises are part of different populations this calls for considering whether the noise requirements at Bornholm should be less strict than at the two other OWFs.

Using the information according to the new guidelines prepared by a working group formed by Energinet.dk will make it possible to determine site specific noise criteria for the three OWFs. The guideline can for instance provide a noise level that is not to be exceeded if all individual porpoise in the area are to be prevented from experiencing PTS.

The guidelines are able to include deterrence of marine mammals from the construction sites. And even though the guidelines are not at present able to predict effects on populations of marine mammals caused by changes in behaviour, the guidelines can be a help when assessing such effects in environmental impact assessments.

Conclusions

The site specific method makes it possible to reduce or avoid noise mitigation costs in some areas, but it also means that it is possible to set a specific criteria that will ensure that populations of marine mammals are not subject to adverse effects in a more sensible way than when a general evaluation is made.

The site specific method will enable environmental assessments to be more precise in evaluation of effects of piling noise on marine mammals.

References

1. Marine mammals and underwater noise in relation to pile driving – Working Group 2014. *Memorandum prepared for Energinet.dk*. 21.01.2015
2. Underwater noise and marine mammals (at the nearcoast OWFs). *Note prepared for Energinet.dk*. In prep.
3. Underwater noise and marine mammals (at Kriegers Flak OWF). *Note prepared for Energinet.dk*. In prep.
4. Tougaard J; Wright AJ; Madsen PT. Cetacean noise criteria revisited in the light of proposed exposure limits for harbour porpoises. *Marine Pollution Bulletin*. 90 (2015) 196-208.

Objectives

In June 2014 Energinet.dk formed a working group with the task of investigating how underwater noise from the installation of impact driven foundations at the planned Danish offshore wind farms can be regulated in order to take due consideration to protected marine mammals.

NIRAS has participated in the work of the group. The first objective was to advice on how noise on the future Horns Rev 3 OWF can be regulated. Since then NIRAS has participated in similar work with the objective of preparing the same advice regarding possible future OWFs at Kriegers Flak, Vesterhav Nord, Vesterhav Syd, Bornholm, Sejerø Bugt, Smålandsfarvandet and Sæby.

Methods

In recent years new knowledge on the hearing of marine mammals has been generated. Therefore, an important aspect of the work has been to update the noise levels that marine mammals can be exposed to without a risk of experiencing temporary thresholds shifts (TTS), permanent threshold shifts (PTS) of effects on behaviour. The differences in the levels used in Danish environmental assessments up till now and the updated levels can be seen in the table below.

Species	Status	Behavioural response (dB SEL)	TTS (dB SEL cum)	PTS (dB SEL cum)
Grey seal and harbour seal	Used up till now	-	171	186
	Updated	-	176	200
Harbour porpoise	Used up till now	145 (single strike)	164	179
	Updated	140 (single strike)	164	183

The German criteria has been based on an effort to prevent harbour porpoise from experiencing TTS caused by a single strike on a monopole foundation or similar. During the work it has been found to be more biological relevant to focus on the cumulated noise levels that marine mammals can be subjected to without experiencing PTS.

However, updating the threshold values and diverting the focus from single strike effects on TTS to cumulated effects on PTS does not solve the problem that a general method means that all projects are met with the same requirements.

In relation with the ongoing environmental assessments of a number of OWFs in Danish waters measures are taken to replace the general method with a site specific method. The method includes an individual based assessment of effects on animal welfare, such as risk of temporary thresholds shifts (TTS) or permanent threshold shifts (PTS).

