Agenda Item 4.2

Priorities in the Implementation of the Triennium Work Plan (2010-2012)
Review of New Information on the Extent of Negative Effects of Sound

Document 4-08

Report of the Noise Working Group

Action Requested

- Take note
- Comment

Submitted by

Noise Working Group

NOTE:
IN THE INTERESTS OF ECONOMY, DELEGATES ARE KINDLY REMINDED TO BRING THEIR OWN COPIES OF DOCUMENTS TO THE MEETING

Report of the open-ended Inter-sessional Working Group on Noise

I Relevant activities and developments including in other international bodies (e.g. ACCOBAMS, HELCOM and OSPAR) and under the EU Marine Strategy Framework Directive;

EU Marine Strategy Framework Directive

In the light of the new EU Marine Strategy Framework Directive (2008/56/EC - descriptor 11: "Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.") the impact of noise needs to be carefully and fully evaluated with the aim to achieve or maintain a good environmental status in the marine environment by 2020. The member states are obliged to conduct assessments to define status and describe a good environmental status by 15 July 2012, by:

- conducting an initial assessment
- making a determination of good environmental status
- establishment of environmental targets

There is a COMMISSION DECISION (1 September 2010) on criteria and methodological standards on good environmental status of marine waters (notified under document C(2010) 5956) which point out: *The criteria for the achievement of good environmental status are the starting point for the development of coherent approaches in the preparatory stages of marine strategies, including the determination of characteristics of good environmental status and the establishment of a comprehensive set of environmental targets, to be developed in a coherent and coordinated manner in the framework of the requirement of regional cooperation.*

The criteria and indicators are developed by a task group. The first approach[1] of that task group was discussed controversially and therefore the working group (EC Technical Subgroup Noise) was reestablished.

The TSG noise was foreseen to run until the end of 2011, but it may very well continue in 2012 or even further (keeping in mind that in 2014 MS have to establish a monitoring program and in 2015 proposals for measures). The actual draft (which should be published by the beginning of the AC 19) contains two indicators:

- Low and mid frequency impulsive noise (Indicator 11.1.1)
- Ambient Noise (Indicator 11.2.1)

and suggest to work on three additional ones

- Medium and high frequency impulsive sounds
- Electromagnetic fields
- Combined mapping of sound levels and sensitivity of marine life

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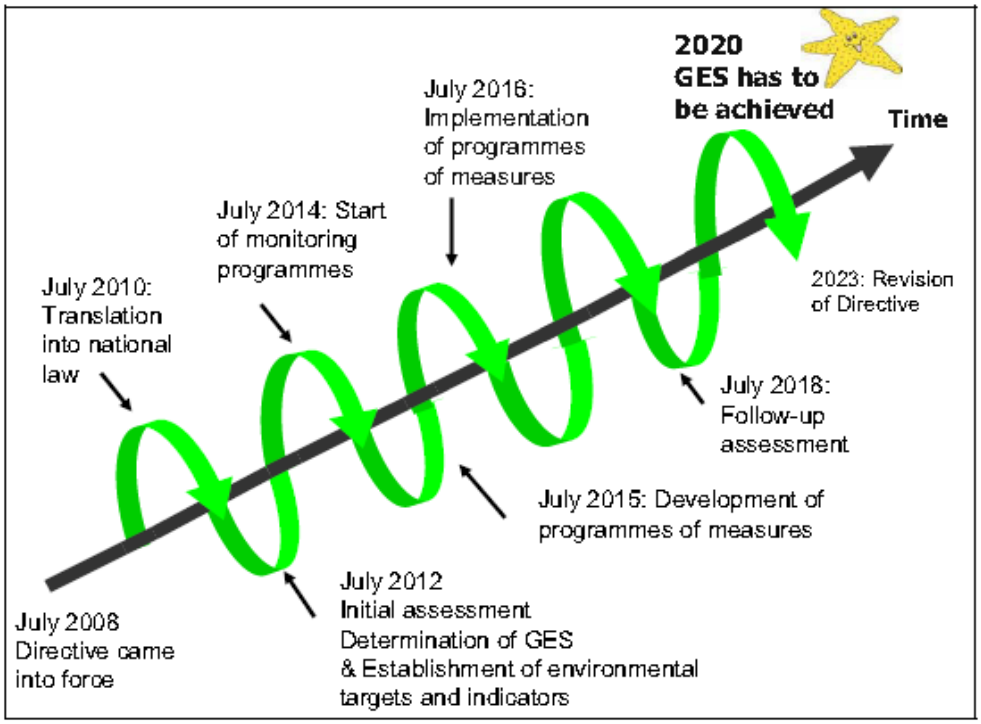
1 http://www.mma.es/secciones/acm/aguas_marinas_litoral/prot_medio_marino/ue_proteccion/pdf/dm_em_tg11_noise.pdf



Implementing the Marine Strategy Framework Directive[2]

ACCOBAMS

Please see: III The potential for joint initiatives on noise and disturbance with ACCOBAMS

HELCOM

no update available

Text from 2011:

Currently there is no sufficient data available to allow for an evaluation of the noise pollution of the Baltic Sea as required by the MSFD. This concerns the entire Baltic area and was as such mentioned and agreed at the HELCOM ministry meeting in May 2010:

“To develop common methodologies and appropriate indicators”;

“to facilitate national and international coordinated monitoring of noise and identification of sources of noise”;

“to further investigate the potential harmful impacts to wildlife from noise.”

In addition the CORESET project of HELCOM and herewithin the Sub-Working-Group developing indicators for marine mammals suggested one indicator on the “Impacts of anthropogenic underwater Noise on Marine Mammals.” As an outcome of the CORESET BD meeting in Gothenburg

[2] FRITZ HOLZWARTH1, WERA LEUJAK[2], JENS ARLE[2] & ULRICH CLAUSSEN2 (2009) Implementing the Marine Strategy Framework Directive (MSFD) in Germany - Moving towards an assessment framework for “good environmental status” in Progress in Marine Conservation in Europe 2009 BfN-Skripten 287 (2011) - 1Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), 2Federal Environment Agency, Germany

in February it was decided to wait for the outcome of the work of the EC-TSG on noise before developing this aspect any further.

Furthermore a “Baltic Sea Information on Acoustic Status project” (BIAS) is proposed by the Swedish Defence Research Agency (FOI) and AquaBiotaWaterResearch. The deployment of about 30-40 autonomous sensors in the Baltic Sea that measure sound in regular intervals during a full year is proposed in order to model the soundscape of difference baltic regions providing “cause-and-effect” interpretation of different anthropogenic activities in order to meet the requirements of the MSFD.

OSPAR

As for HELCOM the overall lack of reliable data on the anthropogenic inputs of underwater noise also concerns for the OSPAR-area including the wider North Sea and is mentioned in the OSPAR “Quality Status Report 2010”:

„Because there are relatively intense concentrations of human activities in some part of the OSPAR area, especially in region II (Greater North Sea) and III and the propobility that these will increase, it is important that the effects of increased levels of underwater sound are fully considered…There is an urgent need to standardise methods for assessing the impacts of sound on marine species and to adress the cumulative effects of different sources.”

The 2009 JAMP Assessment on the environmental impact of underwater noise recommended amongst others that OSPAR Contracting Parties in a next step should develop guidance on measures to mitigate noise emissions and the environmental impacts of underwater noise on the marine environment (OSPAR 2009a). In the QSR 2010 all OSPAR Contracting Parties are invited to develop guidance on best environmental practices (BEP) and best available techniques (BAT) for mitigating noise emmissions and their environmental impacts (OSPAR 2010).
Therefore an OSPAR “Guidance on Measures to Mitigate the Emission and Environmental Impact of Underwater Noise” is now being developed which aims at describing appropriate methods (Best Available Techniques and Best Environmental Practise) that should be applied with the view of mitigating impacts of different underwater noise emitting human activities.

IMO

In October 2008, the Marine Environment Protection Committee (MEPC) of IMO included noise from commercial shipping and its adverse impact on marine life in its work program. A correspondence group has since been working to identify and address ways to minimize the introduction of incidental noise into the marine environment from commercial shipping to reduce the potential adverse impact on marine life and, in particular, develop voluntary technical guidelines for ship-quieting technologies as well as potential navigation and operational practices. A widely endorsed target, including by the Scientific Committee of the IWC, is to reduce the contribution of shipping to ambient noise levels in the 10-300Hz range by 3dB in 10 years and by 10dB in 30 years relative to current levels. Reducing noise output from a vessel can be most effectively achieved at design stage but in some cases there may be noise reduction measures that can be implemented on existing vessels. The overall contribution to ambient noise from shipping is likely to be dominated by the noisiest 10% of vessels which are also the vessels for which noise reduction measures will be the most effective and may be achievable at the same time as improvements in vessel efficiency. In July 2009, the IMO urged governments to review to review of their merchant fleets in order to identify vessels that would benefit most from efficiency improving technologies that are also likely to reduce underwater noise output.

While the issue of underwater noise remains on the agenda of the MEPC, the main work is planned to be conducted by the Design and Equipment (DE) subcommittee. The US submitted a document to the DE subcommittee (DE/56/24) recommending a framework for the development of non-mandatory, technical guidelines to minimize underwater noise, and in particular identifying four specific high-focus areas that should be assessed for potential underwater noise reduction, i.e. propulsion, hull design, onboard machinery and operational modifications. The subcommittee agreed in February 2012 to establish a correspondence group to examine the available options for ship-quieting technologies and operational practices in order to develop non-mandatory draft guidelines for reducing underwater noise from commercial ships.

The International Standards Organisation (ISO) has also been developing standards for the measurement of underwater noise from ships this work has progressed to the Draft International Standard (DIS) stage, and has been given the designator ISO 16554. Publication of the final version of ISO 16554 is scheduled for the second half of 2012.

Following on from the IMO recommendation, MCR Ltd with support from the International Fund for Animal Welfare made some recordings of the acoustic profile of ships. This work was conducted in summer 2011 and aimed to assess aspects of the ISO standards for ship noise measurement in addition to providing data on individual vessels (MCR, 2011)3. A review of practical ways of reducing underwater noise pollution from large commercial vessels is now in press (Leaper and Renilson, 2012).

Further agreements

Furthermore there were a couple of developments at the COP10 of the CBD. Resolution X/13 identifies ocean noise as a "new and emerging issue" and Decision X/29 on Marine and Coastal Biodiversity in paragraph 12 acknowledges that "regional progress has been made in analysing the impacts of underwater noise on marine and coastal biodiversity".

In its decision X/29 (paragraph 12), the 10th Conference of the Parties to the Convention on Biological Diversity recognized the progress that has been made by other organizations in analysing the impacts of underwater noise on marine and coastal biodiversity. CBD Parties requested the Executive Secretary to compile and synthesize available scientific information on anthropogenic underwater noise and its impacts on marine and coastal biodiversity and habitats, and make such information available for consideration at the sixteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), scheduled for April 2012. Accordingly, the CBD Secretariat has prepared a draft report on “Scientific Synthesis on the Impacts of Underwater Noise on Marine and Coastal Biodiversity and Habitats”, which is currently undergoing a review process by Parties and organizations. The joint CMS/ASCOBANS Secretariat has commented on the draft and the SBSTTA paper will be made available to ASCOBANS AC19 if it is published in its final form before the meeting.

The CBD Secretariat is also exploring interest in holding a side event on underwater noise during the upcoming SBSTTA meeting and has enquired with the Secretariat whether CMS/ASCOBANS would be interested in collaborating. They will also invite IMO and OSPAR to this initiative.

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[3] Final Report Describing Measurements of Ship Noise Taken from R/V Song of the Whale in the English Channel and the Hebrides in June and August 2011 Available from http://www.marineconservationresearch.co.uk/wp-content/Downloads/

II Relevant developments and new literature especially with respect to

Technologies aimed at mitigating the propagation of marine noise

2012

Leaper, R. and Renilson, M. A review of practical methods for reducing underwater noise pollution from large commercial vessels. International Journal of Maritime Engineering (in press).

Underwater noise pollution from shipping is of considerable concern for marine life, particularly due to the potential for raised ambient noise levels in the 10-300Hz frequency range to mask biological sounds. There is widespread agreement that reducing shipping noise is both necessary and feasible, and the International Maritime Organization is actively working on the issue. The main source of noise is associated with propeller cavitation, and measures to improve propeller design and wake flow may also reduce noise. It is likely that the noisiest 10% of ships generate the majority of the noise impact, and it may be possible to quieten these vessels through measures that also improve efficiency. However, an extensive data set of full scale noise measurements of ships under operating conditions is required to fully understand how different factors relate to noise output and how noise reduction can be achieved alongside energy saving measures.

2011

Z. Saleem (2011) Alternatives & modifications of monpile foundation

http://www.vliz.be/imisdocs/publications/223688.pdf

→A similar approach but unfortunately in German:

Sven Koschinski, Karin Lüdemann (2011) „Stand der Entwicklung schallminimierender Maßnahmen beim Bau von Offshore-Windenergieanlagen" Studie im Auftrag vom Bundesamt für Naturschutz (BfN)

http://www.bfn.de/habitatmare/de/downloads/berichte/BfN-Studie_Bauschallminderung_Juli-2011.pdf

Andrew J. Wright, Terrence Deak, E.C.M. Parsons. Size matters: Management of stress responses and chronic stress in beaked whales and other marine mammals may require larger exclusion zones. Marine Pollution Bulletin, Volume 63, Issues 1–4, 2011, Pages 5–9.

Marine mammal management traditionally focuses on lethal takes, but non-lethal (or not immediately lethal) impacts of human disturbance, such as prolonged or repeated activation of the stress response, can also have serious conservation implications. The physiological stress response is a life-saving combination of systems and events that maximises the ability of an animal to kill or avoid being killed. However, "chronic stress" is linked to numerous conditions in humans, including coronary disease and infertility. Through examples, including beaked whales and sonar exposure, we discuss increasing human disturbance, mal-adaptive stress responses and chronic stress. Deep-diving and coastal species, and those targeted by whalewatching, may be particularly vulnerable. The various conditions linked with chronic stress in humans would have troubling implications for conservation efforts in endangered species, demands management attention, and may partly explain why some species have not recovered after protective measures (e.g., smaller protected areas) have been put into place.

http://www.biomedsearch.com/nih/Size-matters-Management-stress-responses/20045527.html

Andre, M.; van der Schaar, M.; Zaugg, S.; Houegnigan, L.; Sanchez, A.M. Sea observatories and acoustic events: Towards a global monitoring of ocean noise. Underwater Technology (UT), 2011 IEEE Symposium on and 2011 Workshop on Scientific Use of Submarine Cables and Related Technologies (SSC), Tokyo, 2011

The next decades will see increasing levels of offshore industrial development that will lead to increased amounts of noise pollution in the oceans. Amongst these developments, shipping, oil and gas prospection, navy exercises as well as offshore windmills are already playing a leading role in introducing considerable amount of noise in an increasing number of areas. Underwater sound sources produced by these latter activities present the highest intensity amongst those anthropogenically generated in the sea, reaching more than 230 dB re 1 uPa at 1m from the source. These sounds can have physical, physiological and behavioural effects on the marine fauna in the area of action: mammals, reptiles, fish and invertebrates can be affected at various levels depending on the distance to the sound source. Marine mammals could be one of the more sensitive groups of marine species because they have a highly developed auditory system and use sound actively for feeding and for social communication. It is also known that marine mammals are vulnerable to the effects of habitat loss or reduced survival and reproduction rates. The problem faced by the offshore industry, and more generally by the society, is that many economically important activities at sea are at risk because of a lack of information about the effects of anthropogenic sound on marine mammals and especially a lack of available tools to mitigate these effects. The challenge here is to implement technological developments that combine the interests of the industry and the good environmental status of the oceans. Based on the existing technology successfully implemented at underwater observatories worldwide (European Sea-floor Observatories Network of Excellence, ESONET, European Member States; ANTARES, France; NEPTUNE, Canada; Kushiro, Japan) by the Laboratory of Applied Bioacoustics of the Technical University of Catalonia (LIDO, Listen to the Deep-Ocean Environment, http://listentothedeep.com), a real-time passive - - acoustic monitoring solution is available to monitor ocean noise at large spatial and temporal scales. The LIDO acoustic detection, classification and localization (DCL) system provides continuous information on noise levels and allows the comparative monitoring of noise trends in very diverse geographic locations, as well as relates the presence of key marine species with changing ocean noise.

http://academic.research.microsoft.com/Publication/51050324/sea-observatories-and-acoustic-events-towards-a-global-monitoring-of-ocean-noise

K. Zirbel, P. Balint, E.C.M. Parsons. Navy sonar, cetaceans and the US Supreme Court: A review of cetacean mitigation and litigation in the US. Marine Pollution Bulletin, Volume 63, Issues 1–4, 2011, Pages 40–48.

One source of anthropogenic noise in the oceans which has attracted much concern is naval sonar. As a result of possible impacts of such sonar, several environmental NGOs have pursued legal cases in the United States criticizing environmental assessments conducted prior to exercises and proposed mitigation measures. Cases have been brought using the US National Environmental Protection Act, Marine Mammal Protection Act, Endangered Species Act, Coastal Zone Management Act and other statutes. This paper reviews the chronology and results of these various cases. During the G.W. Bush presidential administration, the legal battle went to the US Supreme Court in the case Winter vs. Natural Resources Defense Council. This case however, did not address the potential impacts of sonar on cetaceans or the effectiveness of mitigation measures. During the Obama administration, mitigation measures for naval exercises have been revised, and working groups planned, in an attempt to resolve conflict between parties.

http://www.sciencedirect.com/science/article/pii/S0025326X11001470

A. Azzellinoa, , , C. Lanfredia, A. D'Amicob, G. Pavanc, M. Podestàd and J. Haune (2010) Risk mapping for sensitive species to underwater anthropogenic sound emissions: Model development and validation in two Mediterranean areas

www.sciencedirect.com

Recent observations of cetacean mass strandings, coincident with anthropogenic sounds emissions, have raised concerns on the potential environmental impact of underwater noise. Cuvier's beaked whale (Ziphius cavirostris) was reported in all the cited stranding events. Within the NATO Marine Mammal Risk Mitigation project (MMRM), multiple interdisciplinary sea trials have been conducted in the Mediterranean Sea with the objective of developing tools and procedures to mitigate the impact of underwater sound emissions. During these cruises, visual observations, passive acoustic detections and environmental data were collected. The aim of this study was to evaluate "a priori" predictions of Cuvier's beaked whale presence in the Alboran Sea, using models developed in the Ligurian Sea that employ bathymetric and chlorophyll features as predictors. The accuracy of these predictions was found adequate and elements are given to account for the uncertainties associated to the use of models developed in areas different from their calibration site.

Caroline Hoeschle (1), Miriam J. Brandt (1), Ansgar Diederichs (1), Klaus Betke (2), Georg Nehls (1) (2011) TESTING THE EFFECTS OF AN ACOUSTIC HARASSMENT DEVICE ON THE BEHAVIOUR OF HARBOUR PORPOISES (*PHOCOENA PHOCOENA*). ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

Acoustic harassment devices (AHD) are regularly used to deter seals from fish farms. While seals can quickly habituate to such devices, previous studies found that the deterring effect on harbour porpoises may reach much further. This is an unwanted side effect in fisheries,

but on the other hand AHDs may be an effective way to deter porpoises before the start of potentially harmful noise emissions from offshore pile driving. However, the spatial scale of deterrence effects of AHDs on porpoises is not sufficiently documented to ensure the prevention of hearing impairment. Using a combination of visual observations and passive acoustic monitoring (C-PODs) we investigated the spatial effects of a Lofitech seal scarer on harbour porpoises. Sighting rates of porpoises significantly declined within the whole 1 km observation radius, and recordings of porpoise echolocation signals by C-PODs were significantly reduced out to a distance of 7 km, with the strongest effect at the nearest PODs and a weak one at further distances. Minimum observed approach distance during 28 hours of AHD activity was 700 m. A response study revealed clear avoidance reactions by porpoises out to the maximum studied distance of 2.6 km. Results show that there is indeed a far reaching effect on porpoise behaviour. This raises concern about unwanted large scale habitat exclusion of porpoises in fisheries, where AHDs are used over long periods of time. On the other hand, the use of AHDs seems to be effective in reducing the number of harbour porpoises exposed to pile driving noise. However, our results also reveal that it is not sufficient to exclude all porpoises from potentially harmful sound.

Ansgar Diederichs (1), Miriam J. Brandt (1), Georg Nehls (1) (2011) DURATION OF RAMMING PROCEDURE HAS A CLEAR EFFECT ON DISPLACEMENT OF HARBOUR PORPOISES. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

In 2009 the first German offshore wind farm “alpha ventus” was built approximately 45km north of the island of Borkum in 30m water depth. The wind farm consists of 12 turbines of which 6 were built on tripod foundations and 6 on jacket foundations, which all had to be rammed into the sea floor. Noise emissions from offshore pile driving may injure marine mammals in the vicinity and cause large-scale disturbance and habitat displacement. We studied the effect of these pile driving activities on harbour porpoises using acoustic dataloggers (T-PODs) that record harbour porpoise echolocation signals and were deployed at different distances to the construction site. We found a clear impact of pile driving on harbour porpoise click recordings. Analysis of relative porpoise activity measured as porpoise positive minutes per hour and waitingtime between consecutive porpoise recordings further revealed a clear difference between the two types of foundations. After the few on average more than five hour lasting piling periods for the tripod foundations animals stayed away from the impact area for a longer time period than after the only one hour lasting piling periods of the jacket foundations. Further the displacement of porpoises during the long lasting ramming periods reached up to greater distances. Consequences of this finding on further development of offshore wind farm constructions in the German Bight will be discussed.

2010

Report of the Working Group on Marine Mammal Ecology (WGMME) ToR 4: Review the effects of wind farm construction and operation on marine mammals and provide advice on monitoring and mitigation schemes

http://www.ices.dk/reports/ACOM/2010/WGMME/wgmme_final_2010.pdf

Significant gaps exist in our knowledge of the possible impacts on the environment from the construction and operation of offshore windfarms. Given the number of windfarms being constructed or planned for realization in the near future, many research projects are currently assessing possible and actual effects of windfarm construction and operation on the different components of ecosystems, such as marine mammals. Also in the near future, developments in tidal turbines and wave generators are likely to increase and although some issues relating to marine mammals may be different from those of offshore windfarms, the general issues of concern remain the same.

Sarah Dolman and Mark Simmonds (2010) Towards best environmental practice for cetacean conservation in developing Scotland's marine renewable energy. Marine Policy, Volume 34, Issue 5, September 2010, Pages 1021-1027

www.sciencedirect.com

Marine renewable energy is seen as an important component of the UK's future energy strategy and contribution to reducing the greenhouse gas emissions responsible for climate change. The UK aims to generate a total of 33 GW (gigawatts) of offshore wind energy. Its implementation strategy includes the development of ten offshore wind farms within Scottish territorial waters. In addition, between 1000 MW (megawatts) and 2600 MW of marine renewable energy generating capacity could be achieved in Scotland using wave and tidal power devices. However, there are negative environmental impacts associated with marine renewable energy. Intense noise is produced during pile driving, drilling and dredging operations with potential consequences for cetaceans. There are also increases in vessel activities during exploration, maintenance and construction with association risks of disturbance and collisions. Some underwater devices will be large and may be positioned in arrays across the habitats that cetaceans frequent. The consequences of encounters between cetaceans and such devices are as yet unknown. It is recommended that the Scottish Government complete full and transparent Marine Spatial Planning, including consideration of cumulative impacts, before moving to license appropriate sites.

Andrew J. Wright, Terrence Deak and E.C.M. Parsons (2010) Size matters: Management of stress responses and chronic stress in beaked whales and other marine mammals may require larger exclusion zones Original Research Article. Marine Pollution Bulletin, In Press, Corrected Proof, Available online 4 January 2010,

www.sciencedirect.com

Marine mammal management traditionally focuses on lethal takes, but non-lethal (or not immediately lethal) impacts of human disturbance, such as prolonged or repeated activation of the stress response, can also have serious conservation implications. The physiological stress response is a life-saving combination of systems and events that maximises the ability of an animal to kill or avoid being killed. However, "chronic stress" is linked to numerous conditions in humans, including coronary disease and infertility. Through examples, including beaked whales and sonar exposure, we discuss increasing human disturbance, mal-adaptive stress responses and chronic stress. Deep-diving and coastal species, and those targeted by whalewatching, may be particularly vulnerable. The various conditions linked with chronic stress in humans would have troubling implications for conservation efforts in endangered species, demands management attention, and may partly explain why some species have not recovered after protective measures (e.g., smaller protected areas) have been put into place.

Nedwell J R , Brooker A G, Bryant S A H and Barham R J (2010) Measurements of Underwater Noise Generated by Acoustic Mitigation Devices. Subacoustech Environmental Report No. E238R0122 to COWRIE. ISBN: 978-0-9565843-2-8

http://www.offshorewind.co.uk/Assets/Final%20report.pdf

This report has been prepared by Subacoustech Environmental Ltd for Collaborative Offshore Research into the Environment (COWRIE) to investigate the acoustic output of a number of Acoustic Mitigation Devices (AMDs). These devices were initially developed for the fisheries industry to prevent predation of farmed fish by marine mammals. Subsequently, however, their use has been expanded into the marine construction sector in order to reduce the potential for injury to marine mammals as a result of exposure to high levels of underwater noise from construction activities such as impact piling or blasting. This study presents the results of a series of measurements of underwater noise during typical operation of several AMDs in carefully controlled experimental conditions. ……

Mark Peter Simmonds A B, Vicki C. Brown A (2010) Is there a conflict between cetacean conservation and marine renewable-energy developments? Wildlife Research 37(8) 688–694 doi:10.1071/WR10020

http://www.publish.csiro.au/paper/WR10020

There is currently an unprecedented expansion of marine renewable-energy developments, particularly in UK waters. Marine renewable-energy plants are also being developed in many other countries across Europe and in the wider world, including in the USA, Canada, New Zealand and Australia. Large-scale developments, in UK waters, covering thousands of square kilometres are now planned; however, data on the likely impact of this expansion on the 28 cetacean species found in UK waters are lacking, or at best limited. However, the available information, including inferences drawn from the impact of other human activities in the marine environment, indicates a significant risk of negative consequences, with the noise from pile driving highlighted as a major concern. The marine renewable-energy industry will also deploy some novel technologies, such as large submerged turbines, with unknown consequences for marine wildlife. Further research is urgently required, including distributional and behavioural studies, to establish baselines against which any changes may be measured. Precautionary actions, particularly with respect to pile driving, are advocated to minimise impacts on cetaceans.

Sarah J. Dolmana, b, , , Peter G.H. Evansc, d, , Giuseppe Notarbartolo-di-Sciarae, f, and Heidrun Frischg, (2010) Active sonar, beaked whales and European regional policy. Marine Pollution Bulletin

www.sciencedirect.com

Various reviews, resolutions and guidance from international and regional fora have been produced in recent years that acknowledge the significance of marine noise and its potential impacts on cetaceans. Within Europe, ACCOBAMS and ASCOBANS have shown increasing attention to the issue. The literature highlights concerns surrounding the negative impacts of active sonar on beaked whales in particular, where concerns primarily relate to the use of mid-frequency active sonar (1–10 kHz), as used particularly in military exercises. The authors review the efforts that European regional policies have undertaken to acknowledge and manage possible negative impacts of active sonar and how these might assist the transition from scientific research to policy implementation, including effective management and mitigation measures at a national level.

E. Ashe, D. P. Noren, R. Williams (2010) Animal behaviour and marine protected areas: incorporating behavioural data into the selection of marine protected areas for an endangered killer whale population. Animal Conservation Volume 13, Issue 2, pages 196–203, April 2010

http://onlinelibrary.wiley.com/doi/10.1111/j.1469-1795.2009.00321.x/full

Like many endangered wildlife populations, the viability and conservation status of 'southern resident' killer whales Orcinus orca in the north-east Pacific may be affected by prey limitation and repeated disturbance by human activities. Marine protected areas (MPAs) present an attractive option to mitigate impacts of anthropogenic activities, but they run the risk of tokenism if placed arbitrarily. Notwithstanding recreational and industrial marine traffic, the number of commercial vessels in the local whalewatching fleet is approaching the number of killer whales to be watched. Resident killer whales have been shown to be more vulnerable to vessel disturbance while feeding than during resting, travelling or socializing activities, therefore protected-areas management strategies that target feeding 'hotspots' should confer greater conservation benefit than those that protect habitat generically. Classification trees and spatially explicit generalized additive models were used to model killer whale habitat use and whale behaviour in inshore waters of Washington State (USA) and British Columbia (BC, Canada). Here we propose a candidate MPA that is small (i.e. a few square miles), but seemingly important. Killer whales were predicted to be 2.7 times as likely to be engaged in feeding activity in this site than they were in adjacent waters. A recurring challenge for cetacean MPAs is the need to identify areas that are large enough to be biologically meaningful while being small enough to allow effective management of human activities within those boundaries. Our approach prioritizes habitat that animals use primarily for the activity in which they are most responsive to anthropogenic disturbance.

Paul M. Thompsona , David Lusseaua, Tim Bartona, Dave Simmonsb, Jan Rusinb and Helen Baileya, (2010) Assessing the responses of coastal cetaceans to the construction of offshore wind turbines Marine Pollution Bulletin Volume 60, Issue 8, August 2010, Pages 1200-1208

www.sciencedirect.com

The expansion of offshore renewables has raised concerns over potential disturbance to coastal cetaceans. In this study, we used passive acoustic monitoring to assess whether cetaceans responded to pile-driving noise during the installation of two 5 MW offshore wind turbines off NE Scotland in 2006. Monitoring was carried out at both the turbine site and a control site in 2005, 2006 and 2007. Harbour porpoises occurred regularly around the turbine site in all years, but there was some evidence that porpoises did respond to disturbance from installation activities. We use these findings to highlight how uncertainty over cetacean distribution and the scale of disturbance effects constrains opportunities for B-A-C-I studies. We explore alternative approaches to assessing the impact of offshore wind farm upon cetaceans, and make recommendations for the research and monitoring that will be required to underpin future developments.

E. A. Becker, K. A. Forney, M. C. Ferguson, D. G. Foley, R. C. Smith, J. Barlow, J. V. Redfern (2010) Comparing California Current cetacean–habitat models developed using in situ and remotely sensed sea surface temperature data. Mar Ecol Prog Ser Vol. 413: 163–183, 2010

http://137.110.142.7/uploadedFiles/Divisions/PRD/Programs/Coastal_Marine_Mammal/Beckeretal_MEPS_2010.pdf

Generalized linear and generalized additive habitat models were used to predict cetacean densities for 10 species in an 818000 km2 area off California. The performance of models built with remotely sensed oceanic data was compared to that of models built with in situ measurements. Cetacean sighting data were collected by the Southwest Fisheries Science Center on 4 systematic line-transect surveys during the summer and fall of 1991, 1993, 1996, and 2001. Predictor variables included temporally dynamic, remotely sensed environmental variables (sea surface temperature and measures of its variance) and more static geographical variables (water depth, bathymetric slope, and a categorical variable representing oceanic zone). The explanatory and predictive power of different spatial and temporal resolutions of satellite data were examined and included in the models for each of the 10 species. Alternative models were built using in situ analogs for sea surface temperature and its variance. The remotely sensed and in situ models with the highest predictive ability were selected based on a pseudo-jackknife cross validation procedure. Environmental predictors included in the final models varied by species, but, for each species, overall explanatory power was similar between the remotely sensed and in situ models. Cetacean–habitat models developed using satellite data at 8 d temporal resolution and from 5 to 35 km spatial resolution were shown to have predictive ability that generally met or exceeded models developed with analogous in situ data. This suggests that the former could be an effective tool for resource managers to develop near real-time predictions of cetacean density.

Wilson, Jennifer C.; Elliott, Mike; Cutts, Nick D.; Mander, Lucas; Mendão, Vera; Perez-Dominguez, Rafael; Phelps, Anna (2010) Coastal and Offshore Wind Energy Generation: Is It Environmentally Benign? Energies 2010, 3, 1383-1422; doi:10.3390/en3071383

http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/6621/Coastal%20and%20Offshore%20Wind%20Energy.pdf?sequence=1

"Offshore and coastal wind power is one of the fastest growing industries in many areas, especially those with shallow coastal regions due to the preferable generation conditions available in the regions. As with any expanding industry, there are concerns regarding the potential environmental effects which may be caused by the installation of the offshore wind turbines and their associated infrastructure, including substations and subsea cables. These include the potential impacts on the biological, physical and human environments. This review discusses in detail the potential impacts arising from offshore wind farm construction, and how these may be quantified and addressed through the use of conceptual models. It concludes that while not environmentally benign, the environmental impacts are minor and can be mitigated through good siting practices. In addition, it suggests that there are opportunities for environmental benefits through habitat creation and conservation protection areas."

Lucke, K., Lepper, P., Blanchet, M.-A. and Siebert, U. The use of an air bubble curtain to reduce the received sound levels for harbor porpoises (Phocoena phocoena)J. Acoust. Soc. Am. (accepted)

In December 2005 construction work was started to replace a harbor wall in Kerteminde harbor, Denmark. A total of 175 wooden piles were piled into the ground at the waters edge over a period of three months. During the same period three harbor porpoises were housed in a marine mammal facility on the opposite side of the harbor. All animals showed strong avoidance reactions after the start of the piling activities. As a measure to reduce the sound exposure for the animals an air bubble curtain was constructed and operated in a direct path between the piling site and the opening of the animals' semi-natural pool. The sound attenuation effect achieved with this system was determined by quantitative comparison of pile driving impulses simultaneously measured in front of and behind the active air bubble curtain. Mean levels of sound attenuation over a sequence of 95 consecutive pile strikes were 14 dB (sd. 3.4 dB) for peak to peak values and 13 dB (sd. 2.5 dB) for SEL values. As soon as the air bubble curtain was installed and operated, no further avoidance reactions of the animals to the piling activities were apparent.

Kastelein, R.A., Hoek, L., Jennings, N., de Jong, C.A.F., Terhune, J.M. & Dieleman, M, (2010) ACOUSTIC MITIGATION DEVICES (AMDs) TO DETER MARINE MAMMALS FROM PILE DRIVING AREAS AT SEA: AUDIBILITY & BEHAVIOURAL RESPONSE OF A HARBOUR PORPOISE & HARBOUR SEALS. COWRIE Ref: SEAMAMD-09, Technical Report 31st July 2010.

http://www.offshorewindfarms.co.uk/Assets/Final%20report%20COWRIE%20Ref%20SEAMAMD-09%20reviewed%20Subac.pdf

For the sustainable development of the offshore renewable energy industry, it is necessary to reduce or avoid the damaging effects of noise (such as death or permanent hearing damage), from activities which produce high sound pressure levels, such as pile driving, on marine mammals. One way to achieve this is to ensure that marine mammals are not present in areas where loud noises are being produced, by deterring them by means of safe sounds produced by Acoustic Mitigation Devices (AMDs). Research is needed to determine whether AMDs can mitigate immediate vicinity impacts of loud sounds, which could give rise to temporary or permanent hearing damage, injury or death of marine mammals. In the North Sea, the two most abundant marine mammal species are the harbour porpoise (Phocoena phocoena) and the harbour seal (Phoca vitulina). COWRIE commissioned SEAMARCO to carry out four studies on the audibility of sounds produced by three selected AMDs and their effect on the behaviour of harbour porpoises and harbour seals (playback experiments). In addition to achieving these aims, SEAMARCO estimated the distances at which sounds from AMDs are audible to, and elicit behavioural responses in, harbour porpoises and harbour seals.

Noise sources that may present a threat to small cetaceans

2012

Sharon L. Nieukirk; David K. Mellinger; Sue E. Moore; Karolin Klinck; Robert P. Dziak; Jean Goslin (2012) Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999–2009. J. Acoust. Soc. Am. 131 (2), February 2012

Between 1999 and 2009, autonomous hydrophones were deployed to monitor seismic activity from 16_ N to 50_ N along the Mid-Atlantic Ridge. These data were examined for airgun sounds produced during offshore surveys for oil and gas deposits, as well as the 20 Hz pulse sounds from fin whales, which may be masked by airgun noise. An automatic detection algorithm was used to identify airgun sound patterns, and fin whale calling levels were summarized via long-term spectral analysis. Both airgun and fin whale sounds were recorded at all sites. Fin whale calling rates were higher at sites north of 32_ N, increased during the late summer and fall months at all sites, and peaked during the winter months, a time when airgun noise was often prevalent. Seismic survey vessels were acoustically located off the coasts of three major areas: Newfoundland, northeast Brazil, and Senegal and Mauritania in West Africa. In some cases, airgun sounds were recorded almost 4000 km from the survey vessel in areas that are likely occupied by fin whales, and at some locations airgun sounds were recorded more than 80% days/month for more than 12 consecutive months. VC 2012 Acoustical Society of America. [DOI: 10.1121/1.3672648]

Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, (2012) Evidence that ship noise increases stress in right whales. Proc. R. Soc. B published online 8 February 2012

Baleen whales (Mysticeti) communicate using low-frequency acoustic signals. These long-wavelength sounds can be detected over hundreds of kilometres, potentially allowing contact over large distances. Low-frequency noise from large ships (20–200 Hz) overlaps acoustic signals used by baleen whales, and increased levels of underwater noise have been documented in areas with high shipping traffic. Reported responses of whales to increased noise include: habitat displacement, behavioural changes and alterations in the intensity, frequency and intervals of calls. However, it has been unclear whether exposure to noise results in physiological responses that may lead to significant consequences for individuals or populations. Here, we show that reduced ship traffic in the Bay of Fundy, Canada, following the events of 11 September 2001, resulted in a 6 dB decrease in underwater noise with a significant reduction below 150 Hz. This noise reduction was associated with decreased baseline levels of stress-related faecal hormone metabolites (glucocorticoids) in North Atlantic right whales (Eubalaena glacialis). This is the first evidence that exposure to low-frequency ship noise may be associated with chronic stress in whales, and has implications for all baleen whales in heavy ship traffic areas, and for recovery of this endangered right whale population. http://rspb.royalsocietypublishing.org/content/early/2012/02/01/rspb.2011.2429

2011

Andrea Pulfrich (2011) ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED SEISMIC SURVEYS IN THE CENTRAL WALVIS BASIN AND SOUTHERN ORANGE BASIN AREAS, NAMIBIA

http://www.ccaenvironmental.co.za/Current%20Projects/Downloads/HRT%20and%20UP/Appendix%204-2%20-%20Marine%20Faunal%20Assessment.pdf

Budzynkiewicz, Jaime (2011) A comparison of Environmental Impact Statement methodologies for assessing sound propagation, density determination and impacts on protected marine mammals: BOEMRE & the U.S. Navy

Sound in the world oceans is an increasingly important conservation issue as human impact throughout the oceans continues to grow without signs of abatement. Deep-water background noise is reported to be doubling every decade. In the U.S. two major sources of underwater sound are the seismic industry (regulated by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)) and Naval sonar. Both of these agencies are required to follow national environmental protocols, such as the National Environmental Policy Act, (NEPA) in regard to their impacts on the environment. These two sound sources produced (or regulated) by two different agencies generate similar impacts to the marine environment, in particular protected marine mammals that rely on sound for survival. The assessment techniques used, and the transparency of the agencies involved is highly in question for actions that produce similar impacts. This master's project analyzes the assessment techniques of BOEMRE and the U.S. Navy concerning underwater sound, exposing the inadequacies and successes of each agency. The analysis was conducted by reading and comparing the techniques used in Environmental Assessments (EA) and Environmental Impact Statements (EIS) produced by both agencies from 2004 to the present. A series of recommendations for both agencies was produced to address the need for more streamlined and transparent analyses that will aid in more accurate and dynamic impact determinations for such projects as the upcoming BOEMRE Programmatic EIS in the Atlantic Planning Region. I have also developed a GIS-based tool that aids in spatial analysis of propagating sound within the marine environment to improve

analysis of potential impacts. This tool allows acoustic propagation models run in the computational program MATLAB® to be imported and integrated in the GIS program ArcGIS ® through the Python scripting language. The integration of this propagation data into GIS allows for better visualizations of sound propagation in 360° around the source and from an aerial perspective. It also allows for further geospatial analysis with other geospatial data such as habitat suitability and species distribution, which can allow for more adaptive species impact determinations and adaptive management for both sonar and seismic survey situations.

http://dukespace.lib.duke.edu/dspace/handle/10161/3639

BENJAMIN TRIMOREAU (2001) Air-gun signal post-processing and sound transmission modelling in shallow water Noise impact of marine seismic exploration on great whales

Marine seismic surveys using a collection of air-guns are commonly used to map sea bottom structures. The noise impact of horizontal air-gun sound transmission in shallow water on marine megafauna as humpback whales is a substantial concern. This paper is part of the 4-year national project BRAHSS (Behavioural Response of Australian Humpback whales to Seismic Surveys). The work aims at studying the sound propagation of air-gun sound impulses through an empirical and a numerical method. The data sets are from the 2010 trials and are used to provide inputs of the numerical model as the geoacoustic properties of the sea bottom. The final outcome is the calculation of the sound exposure levels with range at experimentally followed whales. The bioacoustic tasks aiming at assessing the level of disturbance on the whales will be carry out by bioacousticians from universities of Sydney, Queensland and Curtin.

http://publications.lib.chalmers.se/records/fulltext/148374.pdf

Howard Graya, Koen Van Waerebeek. Postural instability and akinesia in a pantropical spotted dolphin, Stenella attenuata, in proximity to operating airguns of a geophysical seismic vessel. Journal for Nature Conservation 19 (2011) 363– 367

Aberrant behaviour including erratic locomotion was observed in a pantropical spotted dolphin 600 m ahead of an airgun array during 3D seismic explorations off Liberia in March 2009. The dolphin, presumably in acoustic distress, lifted its head and cervical region above the surface in an oblique, strikingly rigid posture during 5 min. Turbulent white-water evidenced a major propulsory thrust. Incremental postural instability and apparent exhaustion progressed to a catatonic-like state of akinesia as the dolphin rolled over onto one side, then its back before sinking virtually motionless close to the airgun array. Unless it recovered full locomotory control, asphyxiation was inevitable. Potential internal injury is discussed, both acoustic-mediated and from extreme exertion (exertional myopathy, rhabdomyolysis and myoglobinuric nephrosis). As behaviour was spatially and temporally closely associated with firing seismic airguns, we suggest a cause–effect relationship. Differential diagnoses of pre-existing morbidity, senescence, or intoxication are considered possible but unlikely.

Miriam J. Brandt, Ansgar Diederich, Klaus Betke, Georg Nehl. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. MARINE ECOLOGY PROGRESS SERIES Vol. 421: 205–216, 2011 doi: 10.3354/meps08888

Pile driving during offshore windfarm construction goes along with considerable noise emissions that potentially harm marine mammals in the vicinity and may cause large scale disturbances. Information on the scale of such disturbances is limited. Therefore, assessment and evaluation of the effects of offshore construction on marine mammals is difficult. During summer 2008, 91 monopile foundations were driven into the seabed during construction of the offshore wind farm Horns Rev II in the Danish North Sea. We investigated the spatial and temporal scale of behavioural responses of harbour porpoises Phocoena phocoena to construction noise using passive acoustic monitoring devices (T-PODs) deployed in a gradient sampling design. Porpoise acoustic activity was reduced by 100% during 1 h after pile driving and stayed below normal levels for 24 to 72 h at a distance of 2.6 km from the construction site. This period gradually decreased with increasing distance. A negative effect was detectable out to a mean distance of 17.8 km. At 22 km it was no longer apparent, instead, porpoise activity temporarily increased. Out to a distance of 4.7 km, the recovery time was longer than most pauses between pile driving events. Consequently, porpoise activity and possibly abundance were reduced over the entire 5 mo construction period. The behavioural response of harbour porpoises to pile driving lasted much longer than previously reported. This information should be considered when planning future wind farm construction.

http://www.miriambrandt.de/publications.htm

Jason Gedamke, Nick Gales, and Sascha Frydman. Assessing risk of baleen whale hearing loss from seismic surveys: The effect of uncertainty and individual variation. J. Acoust. Soc. Am. Volume 129, Issue 1, pp. 496-506 (2011); (11 pages)

The potential for seismic airgun “shots” to cause acoustic trauma in marine mammals is poorly understood. There are just two empirical measurements of temporary threshold shift (TTS) onset levels from airgun-like sounds in odontocetes. Considering these limited data, a model was developed examining the impact of individual variability and uncertainty on risk assessment of baleen whale TTS from seismic

surveys. In each of 100 simulations: 10000 “whales” are assigned TTS onset levels accounting for: inter-individual variation; uncertainty over the population’s mean; and uncertainty over weighting of odontocete data to obtain baleen whale onset levels. Randomly distributed whales are exposed to one seismic survey passage with cumulative exposure level calculated. In the base scenario, 29% of whales (5th/95th percentiles of 10%/62%) approached to 1–1.2 km range were exposed to levels sufficient for TTS onset. By comparison, no whales are at risk outside 0.6 km when uncertainty and variability are not considered. Potentially “exposure altering” parameters (movement, avoidance, surfacing, and effective quiet) were also simulated. Until more research refines model inputs, the results suggest a reasonable likelihood that whales at a kilometer or more from seismic surveys could potentially be susceptible to TTS and demonstrate the large impact uncertainty and variability can have on risk assessment.

http://asadl.org/jasa/resource/1/jasman/v129/i1/p496_s1?isAuthorized=no

Ronald A. Kastelein, Nele Steen, Christ de Jong, Paul J. Wensveen, and Willem C. Verboom . Effect of broadband-noise masking on the behavioral response of a harbor porpoise (*Phocoena phocoena*) to 1-s duration 6–7 kHz sonar up-sweeps. J. Acoust. Soc. Am. Volume 129, Issue 4, pp. 2307-2315 (2011); (9 pages)

Naval sonar systems produce signals which may affect the behavior of harbor porpoises, though their effect may be reduced by ambient noise. To show how natural ambient noise influences the effect of sonar sweeps on porpoises, a porpoise in a pool was exposed to 1-s duration up-sweeps, similar in frequency range (6–7 kHz) to those of existing naval sonar systems. The sweep signals had randomly generated sweep intervals of 3–7 s (duty cycle: 19%). Behavioral parameters during exposure to signals were compared to those during baseline periods. The sessions were conducted under five background noise conditions: the local normal ambient noise and four conditions mimicking the spectra for wind-generated noise at Sea States 2–8. In all conditions, the sweeps caused the porpoise to swim further away from the transducer, surface more often, swim faster, and breathe more forcefully than during the baseline periods. However, the higher the background noise level, the smaller the effects of the sweeps on the surfacing behavior of the porpoise. Therefore, the effects of naval sonar systems on harbor porpoises are determined not only by the received level of the signals and the hearing sensitivity of the animals but also by the background noise.

http://asadl.org/jasa/resource/1/jasman/v129/i4/p2307_s1?isAuthorized=no

Ronald A. Kastelein, Lean Hoek, and Christ A. F. de Jong. Hearing thresholds of a harbor porpoise (*Phocoena phocoena*) for sweeps (1–2 kHz and 6–7 kHz bands) mimicking naval sonar signals. J. Acoust. Soc. Am. Volume 129, Issue 5, pp. 3393-3399 (2011); (7 pages)

The distance at which active naval sonar signals can be heard by harbor porpoises depends, among other factors, on the hearing thresholds of the species for those signals. Therefore the hearing sensitivity of a harbor porpoise was determined for 1 s up-sweep and down-sweep signals, mimicking mid-frequency and low-frequency active sonar sweeps (MFAS, 6–7 kHz band; LFAS, 1–2 kHz band). The 1–2 kHz sweeps were also tested with harmonics, as sonars sometimes produce these as byproducts of the fundamental signal. The hearing thresholds for up-sweeps and down-sweeps within each sweep pair were similar. The 50% detection threshold sound pressure levels (broadband, averaged over the signal duration) of the 1–2 kHz and 6–7 kHz sweeps were 75 and 67 dB re 1 μPa2, respectively. Harmonic deformation of the 1–2 kHz sweeps reduced the threshold to 59 dB re 1 μPa2. This study shows that the presence of harmonics in sonar signals can increase the detectability of a signal by harbor porpoises, and that tonal audiograms may not accurately predict the audibility of sweeps. LFAS systems, when designed to produce signals without harmonics, can operate at higher source levels than MFAS systems, at similar audibility distances for porpoises.

http://asadl.org/jasa/resource/1/jasman/v129/i5/p3393_s1?isAuthorized=no

Ronald A. Kastelein1, Lean Hoek1, and Christ A. F. de Jong. Hearing thresholds of a harbor porpoise (*Phocoena phocoena*) for helicopter dipping sonar signals (1.43–1.33 kHz) (L). J. Acoust. Soc. Am. Volume 130, Issue 2, pp. 679-682 (2011); (4 pages)

Helicopter long range active sonar (HELRAS), a “dipping” sonar system used by lowering transducer and receiver arrays into water from helicopters, produces signals within the functional hearing range of many marine animals, including the harbor porpoise. The distance at which the signals can be heard is unknown, and depends, among other factors, on the hearing sensitivity of the species to these particular signals. Therefore, the hearing thresholds of a harbor porpoise for HELRAS signals were quantified by means of a psychophysical technique. Detection thresholds were obtained for five 1.25 s simulated HELRAS signals, varying in their harmonic content and amplitude envelopes. The 50% hearing thresholds for the different signals were similar: 76 dB re 1 μPa (broadband sound pressure level, averaged over the signal duration). The detection thresholds were similar to those found in the same porpoise for tonal signals in the 1–2 kHz range measured in a previous study. Harmonic distortion, which occurred in three of the five signals, had little influence on their audibility. The results of this study, combined with information on the source level of the signal, the propagation conditions and ambient noise levels, allow the calculation of accurate estimates of the distances at which porpoises can detect HELRAS signals.

http://asadl.org/jasa/resource/1/jasman/v130/i2/p679_s1?isAuthorized=no

Vladimir V. Popov, Alexander Ya. Supin, Ding Wang, Kexiong Wang, Lijun Dong, and Shiyong Wang. Noise-induced temporary threshold shift and recovery in Yangtze finless porpoises *Neophocaena phocaenoides asiaeorientalis.* J. Acoust. Soc. Am. Volume 130, Issue 1, pp. 574-584 (2011); (11 pages)

In Yangtze finless porpoises *Neophocaena phocaenoides asiaeorientalis*, the effects of fatiguing noise on hearing thresholds at frequencies of 32, 45, 64, and 128 kHz were investigated. The noise parameters were: 0.5-oct bandwidth, −1 to +0.5 oct relative to the test frequency, 150 dB re 1 μPa (140–160 dB re 1 μPa in one measurement series), with 1–30 min exposure time. Thresholds were evaluated using the evoked-potential technique allowing the tracing of threshold variations with a temporal resolution better than 1 min. The most effective fatiguing noise was centered at 0.5 octave below the test frequency. The temporary threshold shift (TTS) depended on the frequencies of the fatiguing noise and test signal: The lower the frequencies, the bigger the noise effect. The time-to-level trade of the noise effect was incomplete: the change of noise level by 20 dB resulted in a change of TTS level by nearly 20 dB, whereas the tenfold change of noise duration resulted in a TTS increase by 3.8–5.8 dB.

http://asadl.org/jasa/resource/1/jasman/v130/i1/p574_s1?isAuthorized=no

Meike Scheidat, Jakob Tougaard, Sophie Brasseur, Jacob Carstensen, Tamara van Polanen Petel, Jonas Teilmann and Peter Reijnders. Harbour porpoises (Phocoena phocoena) and wind farms: a case study in the Dutch North Sea. *Environ. Res. Lett.* 6 025102 doi:10.1088/1748-9326/6/2/025102

The rapid increase in development of offshore wind energy in European waters has raised concern for the possible environmental impacts of wind farms. We studied whether harbour porpoise occurrence has been affected by the presence of the Dutch offshore wind farm Egmond aan Zee. This was done by studying acoustic activity of porpoises in the wind farm and in two reference areas using stationary acoustic monitoring (with T-PODs) prior to construction (baseline: June 2003 to June 2004) and during normal operation of the wind farm (operation: April 2007 to April 2009). The results show a strong seasonal pattern, with more activity recorded during winter months. There was also an overall increase in acoustic activity from baseline to operation, in line with a general increase in porpoise abundance in Dutch waters over the last decade. The acoustic activity was significantly higher inside the wind farm than in the reference areas, indicating that the occurrence of porpoises in this area increased as well. The reasons of this apparent preference for the wind farm area are not clear. Two possible causes are discussed: an increased food availability inside the wind farm (reef effect) and/or the absence of vessels in an otherwise heavily trafficked part of the North Sea (sheltering effect).

http://iopscience.iop.org/1748-9326/6/2/025102

Crystal, Danica; Moseley, Kristina; Paterson, Cassandra; Ryvola, Rebeka; Wang, Shasha. 2011. Commercial Shipping Noise Impacts on the Critical Habitat of the Southern Resident Killer Whale (Orcinus orca). Environmental Science Undergraduate Research Paper. Department of Earth and Ocean Sciences. University of British Columbia.

Southern resident killer whales (SRKWs), found commonly on the south coast of British Columbia, are an endangered species struggling to maintain its population size. The critical habitat of the SRKW, an area important to the recovery of the species, is also an area traversed by commercial ships on a daily basis. Among other challenges to the whales such as habitat destruction and contamination, noise pollution produced by these commercial ships is one of the threats preventing the recovery of the SRKWs, through masking of whale communications. Masking, the interruption of killer whale vocalizations by background noise produced by ships, reduces group cohesion and forces the whales to spend more time and energy foraging, ultimately decreasing their ability to reproduce and sustain their population. The Canadian Federal Court recently established that protection of this endangered species, managed by the Department of Fisheries and Oceans (DFO), must take into account the impact of noise pollution on the whales, a factor that has not yet been considered. With an expected increase in commercial shipping to BC facilitated by expansions at two ports, there is potential for further threats to the SRKWs through masking of vocalizations. The purpose of this study is to examine the current masking sounds created by commercial ships in the critical habitat of the SRKW and to determine whether imposing speed limits on ships can reduce the amount of masking that occurs. The objectives of this study are to: 1. Identify the areas on the south coast of BC where ships have the potential to mask the SRKW vocalizations when the whales are inshore (May through October). 2. Determine the frequency of masking within these areas. 3. Model speed limit scenarios imposed on ships and assess the effectiveness of these limits at reducing masking sounds. 4. Recommend further research that will contribute to minimizing the effect of ship noise on this endangered population.

https://circle-prod.library.ubc.ca/handle/2429/34597

Southall, B. ; Calambokidis, J. ; Tyack, P. ; Moretti, D. ; Hildebrand, J. ; Kyburg, C. ; Carlson, R. ; Friedlaender, A. ; Falcone, E. ; Schorr, G. Biological and Behavioral Response Studies of Marine Mammals in Southern California, 2010 ("SOCAL-10"). DTC Online Project Rep., 26 FEB 2011, Accession Number: ADA538910

SOCAL-10 was a scientific research project conducted in Aug-Sept 2010 in the Southern California Bight. The overall objective was to provide a better understanding of marine mammal behavior, while providing direct scientific data for the Navy and regulatory agencies to estimate risk and minimize adverse effects of human sounds, particularly military sonar. SOCAL-10 extended previous studies in the Bahamas (2007-08) and Mediterranean Sea (2009) of whether and how marine mammals change their behavior when they hear different sounds; each effort integrated behavioral response studies (BRS) with ongoing research on diving, foraging, and social behavior. SOCAL-10 was the first in a five-year dedicated effort to study a variety of marine mammals in this area. Like previous behavioral response studies (BRS) using controlled (sound) exposure experiment (CEE) methods, SOCAL-10 involved an interdisciplinary collaboration of experts in marine mammal biology, behavior, and communication, as well as underwater acousticians and specialized field researchers. During a preliminary scouting phase and two research legs on different research vessels, SOCAL-10 observed, photographed, and/or tracked in detail, individuals of 21 different marine mammal species. Sixty-three tags (of six different varieties) were successfully secured on 44 individual animals of at least eight different marine mammal species, including several for which little or no comparable tag data previously existed.

http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA538910

Rob Willams, Erin Ashe, Doug Sandilands & David Lusseau. Stimulus-dependent response to disturbance affecting the activity of killer whales. International Whaling Commission, Document SC/63/WW5 (2011)

Humans seeking to observe wildlife in their natural habitat can disrupt the activity of the individuals they target. One hypothesis is that behavioral reactions emerge from animals perceiving humans as a potential risk. If it was the case we expect the avoidance tactics to be mediated to account for the difference in risk factors different platforms might present. We examined whether behavioral responses of northern resident killer whales differed between powerboats and kayaks to test this prediction. Killer whales responded to kayaks by increasing their probability to switch to travelling activity more often than during control (no-boat) conditions. As a result, killer whales spent significantly more time traveling when in the presence of kayaks than they did under control, no-boat conditions (11% increase in time spent travelling). Consistent with previous studies examining the effects of powerboats, killer whales significantly reduced overall time spent feeding in the presence of kayaks and powerboats (30% decrease in the time spent feeding). Overall, we show that killer whales have different avoidance tactics to deal with the two types of vessels (motorized or not) and that they will try to outpace kayaks because those cannot follow them. The presence of motorized vessels, particularly vessels targeting whales, decreased the odds that killer whales were feeding (odds ratio: 0.70, 95% CI: 0.62-0.79). The presence of kayaks increased the odds that killer whales were traveling (odds ratio: 1.13, 95% CI: 1.001-1.280). Silent vessels (kayaks) can therefore elicit avoidance tactics like boats that have an acoustic signature do. Such findings are consistent with observed risk avoidance strategies in long-lived mammals. These avoidance strategies have different energetic consequences. While both kayaks and powerboats affect both feeding and travelling behavior, kayaks tend to increase killer whales' energetic demand while powerboats tend to decrease their opportunities to acquire energy.

http://iwcoffice.org/_documents/sci_com/SC63docs/SC-63-WW5.pdf

Koschinski, Sven. Underwater Noise Pollution From Munitions Clearance and Disposal, Possible Effects on Marine Vertebrates, and Its Mitigation. Marine Technology Society Journal, Volume 45, Number 6, November/December 2011 , pp. 80-88(9).

Underwater detonations have the potential for serious injury in marine vertebrates such as fishes, reptiles, birds and mammals. The high detonation velocity creates a shock wave. The main reason for injury is the extremely short signal rise time combined with a high overpressure. A negative pressure phase generating cavitation shortly after the peak overpressure can increase organ and tissue damage. Due to surface reflection generating a reversed phase replica of the detonation, this phenomenon is very pronounced in shallow waters. Organs most seriously affected by detonations are those with gas/tissue interfaces (e.g., ears, lungs, swim bladders, air sacs, intestines). Observed injuries include disruption of cells and tissues by differential displacement, internal bleeding, embolism, and auditory damage. Furthermore, compression of the thorax by the shock wave initiates a rapid increase in blood pressure, which can cause damage in the brain and ears. In order to protect marine life, all possible attempts should be made to avoid underwater detonations. For detonations that cannot be avoided due to safety considerations, a number of mitigation measures are presented including bubble curtains, scaring devices, visual and acoustic monitoring, and seasonal and spatial planning. However, mitigation measures have varying degrees of efficiency. Low-order detonations are not a real alternative due to the release of toxic munitions constituents to the environment. For each detonation, a proper site- and munitions-specific risk assessment and mitigation strategy must be developed.

http://www.ingentaconnect.com/content/mts/mtsj/2011/00000045/00000006/art00011

Mark Peter Simmonds, Vicki C. Brown. Is there a conflict between cetacean conservation and marine renewable-energy developments? *Wildlife Research* 37(8) 688–694 http://dx.doi.org/10.1071/WR10020

There is currently an unprecedented expansion of marine renewable-energy developments, particularly in UK waters. Marine renewable-energy plants are also being developed in many other countries across Europe and in the wider world, including in the USA, Canada, New Zealand and Australia. Large-scale developments, in UK waters, covering thousands of square kilometres are now planned; however, data on the likely impact of this expansion on the 28 cetacean species found in UK waters are lacking, or at best limited. However, the available information, including inferences drawn from the impact of other human activities in the marine environment, indicates a significant risk of negative consequences, with the noise from pile driving highlighted as a major concern. The marine renewable-energy industry will also deploy some novel technologies, such as large submerged turbines, with unknown consequences for marine wildlife. Further research is urgently required, including distributional and behavioural studies, to establish baselines against which any changes may be measured. Precautionary actions, particularly with respect to pile driving, are advocated to minimise impacts on cetaceans.

http://www.publish.csiro.au/paper/WR10020

Tyack PL, Zimmer WMX, Moretti D, Southall BL, Claridge DE, et al. (2011) Beaked Whales Respond to Simulated and Actual Navy Sonar. PLoS ONE 6(3): e17009. doi:10.1371/journal.pone.0017009

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0017009

Beaked whales have mass stranded during some naval sonar exercises, but the cause is unknown. They are difficult to sight but can reliably be detected by listening for echolocation clicks produced during deep foraging dives. Listening for these clicks, we documented Blainville's beaked whales, *Mesoplodon densirostris*, in a naval underwater range where sonars are in regular use near Andros Island, Bahamas. An array of bottom-mounted hydrophones can detect beaked whales when they click anywhere within the range. We used two complementary methods to investigate behavioral responses of beaked whales to sonar: an opportunistic approach that monitored whale responses to multi-day naval exercises involving tactical mid-frequency sonars, and an experimental approach using playbacks of simulated sonar and control sounds to whales tagged with a device that records sound, movement, and orientation. Here we show that in both exposure conditions beaked whales stopped echolocating during deep foraging dives and moved away. During actual sonar exercises, beaked whales were primarily detected near the periphery of the range, on average 16 km away from the sonar transmissions. Once the exercise stopped, beaked whales gradually filled in the center of the range over 2–3 days. A satellite tagged whale moved outside the range during an exercise, returning over 2–3 days post-exercise. The experimental approach used tags to measure acoustic exposure and behavioral reactions of beaked whales to one controlled exposure each of simulated military sonar, killer whale calls, and band-limited noise. The beaked whales reacted to these three sound playbacks at sound pressure levels below 142 dB re 1 µPa by stopping echolocation followed by unusually long and slow ascents from their foraging dives. The combined results indicate similar disruption of foraging behavior and avoidance by beaked whales in the two different contexts, at exposures well below those used by regulators to define disturbance.

Elena McCarthy, David Moretti, Len Thomas, Nancy DiMarzio, Ronald Morrissey, Susan Jarvis, Jessica Ward, Annamaria Izzi, Ashley Dilley (2011) Changes in spatial and temporal distribution and vocal behavior of Blainville's beaked whales (Mesoplodon densirostris) during multiship exercises with mid-frequency sonar. Marine Mammal Science first published online: 24 FEB 2011

http://onlinelibrary.wiley.com/doi/10.1111/j.1748-7692.2010.00457.x/abstract

The number and distribution of vocalizing groups of Blainville's beaked whales (Mesoplodon densirostris) were analyzed before, during, and after multiship mid-frequency active sonar operations at the US Navy's Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas. Groups of foraging animals were isolated by detecting their echolocation clicks using an array of bottom-mounted hydrophones. Two data sets were evaluated consisting of 115 and 240 h of acoustic data in May 2007 and 2008, respectively. Vocal activity was observed to decline during active sonar exercises and increase upon cessation of sonar transmissions in both data sets. Vocal activity did not recover to preexposure levels in the postexposure time period in 2007 nor in the initial postexposure period in the 2008 data set. Clicks detected during sonar operations were generally found to be on the periphery of the hydrophone field and vocal durations declined for those groups that remained on the range in that time period. Receive levels were calculated for several vocal groups of whales and indicated that animals continued to forage when exposed to sonar at levels as high as 157 dB re: µPa.

Purser J, Radford AN (2011) Acoustic Noise Induces Attention Shifts and Reduces Foraging Performance in Three-Spined Sticklebacks (Gasterosteus aculeatus). PLoS ONE 6(2): e17478. doi:10.1371/journal.pone.0017478

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0017478

Acoustic noise is known to have a variety of detrimental effects on many animals, including humans, but surprisingly little is known about its impacts on foraging behaviour, despite the obvious potential consequences for survival and reproductive success. We therefore exposed captive three-spined sticklebacks (Gasterosteus aculeatus) to brief and prolonged noise to investigate how foraging performance is affected by the addition of acoustic noise to an otherwise quiet environment. The addition of noise induced only mild fear-related behaviours - there was an increase in startle responses, but no change in the time spent freezing or hiding compared to a silent control - and thus had no significant impact on the total amount of food eaten. However, there was strong evidence that the addition of noise increased food-handling errors and reduced discrimination between food and non-food items, results that are consistent with a shift in attention. Consequently, noise resulted in decreased foraging efficiency, with more attacks needed to consume the same number of prey items. Our results suggest that acoustic noise has the potential to influence a whole host of everyday activities through effects on attention, and that even very brief noise exposure can cause functionally significant impacts, emphasising the threat posed by ever-increasing levels of anthropogenic noise in the environment.

Laurent Seuront and Nardi Cribb (2011) Fractal analysis reveals pernicious stress levels related to boat presence and type in the Indo–Pacific bottlenose dolphin, Tursiops aduncus Physica A: Statistical Mechanics and its Applications, In Press, Corrected Proof, Available online 18 February 2011,

www.sciencedirect.com

The stress induced in the Indo–Pacific bottlenose dolphin, Tursiops aduncus, by boat presence and type was investigated in a highly urbanized coastal environment, the Port Adelaide River-Barker Inlet Estuary, South Australia. The level of stress experienced by bottlenose dolphins was inferred from the distribution patterns of their dive durations. Dive duration has previously been shown to increase under boat traffic conditions, and is considered as a typical avoidance behavior. Dive durations were opportunistically recorded from land-based stations between January 2008 and October 2010 in the absence of boat traffic, and in the presence of kayaks, inflatable motor boats, powerboats and fishing boats. Subsequent analyses were based on nearly 6000 behavioral observations. No significant differences in dive durations were found between control observations (i.e. absence of boats) and boat interferences, which could erroneously lead to conclude that boat traffic did not induce any stress in T. aduncus. In contrast, the scaling exponents of the cumulative probability distribution of dive durations obtained in the absence of boat traffic and under different conditions of boat interferences show (i) that the presence of boats affected the complexity of dive duration patterns and (ii) that stress levels were a function of boat type. Specifically, the complexity of dive duration patterns (estimated by the scaling exponent) did not significantly differ between control behavioral observations and behavioral observations conducted in the presence of kayaks. A significant increased in behavioral stress (i.e. decreasing values of) was, however, induced by the presence of fishing boats, motorized inflatable boats and powerboats. This demonstrates that traditional approaches based on the analysis of averaged behavioral metrics may not be sensitive enough to detect changes in the distribution pattern of behavioral sequences, hence underestimate the potential consequences of e.g. chronic exposure to low levels of stress. It is finally emphasized that fractal analyses of behavioral variables, and in particular the analysis of their cumulative probability distribution function, may provide a non-invasive, objective and quantitative framework that can be used to assess the changes in stress response, and subsequently evaluate the welfare status of organisms under various conditions of abiotic and/or biotic stress.

A. Azzellino, C. Lanfredi, A. D'Amico, G. Pavan, M. Podestà and J. Haun (2011) Risk mapping for sensitive species to underwater anthropogenic sound emissions: Model development and validation in two Mediterranean areas Original Research Article. Marine Pollution Bulletin, In Press, Corrected Proof, Available online 24 February 2011,

www.sciencedirect.com

Recent observations of cetacean mass strandings, coincident with anthropogenic sounds emissions, have raised concerns on the potential environmental impact of underwater noise. Cuvier's beaked whale (Ziphius cavirostris) was reported in all the cited stranding events. Within the NATO Marine Mammal Risk Mitigation project (MMRM), multiple interdisciplinary sea trials have been conducted in the Mediterranean Sea with the objective of developing tools and procedures to mitigate the impact of underwater sound emissions. During these cruises, visual observations, passive acoustic detections and environmental data were collected. The aim of this study was to evaluate "a priori" predictions of Cuvier's beaked whale presence in the Alboran Sea, using models developed in the Ligurian Sea that employ bathymetric and chlorophyll features as predictors. The accuracy of these predictions was found adequate and elements are given to account for the uncertainties associated to the use of models developed in areas different from their calibration site.

Lucke, K., Dähne, M., Peschko, V., Müller, S., Adler, S., Gilles, A., Krügel, K., Brandecker, A., Sundermeyer, J., Verfuss, U., Benke, H. and Siebert, U. (2011) StUKplus: Investigations in addition to the effects monitoring – marine mammals. Proceedings of the Meeresumwelt-Symposium, Hamburg, p.61-62.

During the construction phase of the offshore test site alpha ventus, aerial and ship surveys were conducted to monitor the abundance and distribution of harbour porpoises in the study area. Moreover, their presence and behaviour were monitored using C-PODs, automatic cetacean echolocation loggers. The aim of these efforts was to find out whether the construction had any significant effect on the presence and habitat use of harbour porpoises in the study. The results show a significant negative correlation between pile driving activities and porpoise presence in a wide area around alpha ventus during the construction activities in 2008 and the first part of the 2009 construction phase. The effect was monitored over a range of at least 8 km and up to 25 km. An aerial survey conducted immediately after pile driving at one of the first turbine foundation sites showed a different porpoise distribution: no animals were sighted close to alpha ventus, and many animals were sighted at greater distances. Thus acoustic and visual data concordantly showed that harbor porpoises initially avoid the pile driving area over wide ranges for an extended period of time (hours to days). Of special importance is the fact that the number of acoustic detections of harbour porpoises in the vicinity of the pile driving sites increased during the construction of the last wind turbines in 2009. The increased presence of harbour porpoises in the impact area implies that these animals were exposed to a large number of piling impulses (several thousand impulses per pile on average) at high received sound levels. Such a multiple exposure poses the risk of impairing the animals' hearing. It is most likely that porpoises in the vicinity of the construction site have been physically impaired.

Jakob Tougaard , Line Anker Kyhn , Mats Amundin, Daniel Wennerberg , Carolina Bordin (2011) HARBOUR PORPOISES ARE DETERRED BY SIMULATED PILE DRIVING NOISE. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

Many studies have shown that harbour porpoises react to loud underwater sound, including impact noise from pile driving of large diameter monopiles, such as those used as foundations for offshore wind turbines. Previous studies showed that fewer echolocation clicks are recorded following pile drivings, but it remains unclear whether the porpoises vacated the area around the construction site or remained in the area, but with an altered acoustic behaviour. To address this question a controlled exposure study was conducted. Pile driving sounds were played back at reduced levels (about 180 dB re. 1 uPa peak-peak at 1 m) from underwater loudspeakers (Lubell 9162) located close to shore at Fyns Hoved, Great Belt, Denmark. The swimming behaviour of porpoises was tracked visually by a theodolite from a nearby clifftop. Porpoises were tracked continuously for long periods and playback occurred as 2-hour blocks with one pile driving sound being played back every second. Playback occurred from one of two identical loudspeakers, separated by about 200 m and without observers being aware whether the sound was on or not, to avoid observer bias. A maximum of 2 playback blocks occurred per day. Results show that porpoises avoided a zone with a distance of c. 200m around the loudspeakers when these were transmitting. Received levels of sound at this distance was around 140 dB re. 1 uPa (peak-peak). This threshold level for reactions is consistent with the results from the real pile drivings. Thus, even though the source levels in the controlled exposure study was 50-60 dB lower than a real pile driving and hence the size of the impact area greatly reduced, the thresholds for reaction are consistent. This gives confidence to concluding that porpoises likely react in a similar way to real pile drivings, i.e. by vacating the area.

Sylvia Eke van der Woude (2011) ACOUSTIC AND LOCOMOTIVE RESPONSES OF BOTTLENOSE DOLPHINS, *TURSIOPS TRUNCATUS*, TO AN ACOUSTIC MARINE GEOPHYSICAL SURVEY. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

Investigations of the effects of anthropogenic noise on marine mammals often lack full experimental control. This study provides detailed data on the noise source and the receiver, namely a geophysical survey and bottlenose dolphins. The seismic and bathymetric survey was shot on 19 days in November 2006 in the Red Sea. The area included an extensive open-sea enclosure accommodating 10 dolphins. Five different sound producing devices were simultaneously applied. GPS log files supplied information on their distance to the enclosure, speed, and direction. The dolphins' behaviour was monitored both visually and acoustically. Commented visual recordings were made from an observation tower and linked to acoustic recordings obtained from a spacious hydrophone-array. Recordings were analyzed in 10s-intervals. Acoustic recordings (15h) were examined for the slightest indication of vocal activity discernable below 24kHz, including whistles and echolocation clicks. Visual recordings (3h) were examined for the position, velocity, swimming association, and behavior of each individual within sight. All vocalizations analyzed were dramatically reduced on survey days compared to control days. This reduction was the more pronounced the closer the devices were and the faster they were approaching. Also locomotive behavior was clearly affected by noise. At shorter distances (below 2.2km) swimming speed increased and other behaviors such as social interactions were reduced if not fully absent. At highest speeds mother-calve separations occurred. Both, the reduction or frequency shift of signals used for communication and orientation and the changes of locomotive behaviors must be considered as costly. Although there were no indications for injuries like deafness (TTS/PTS), the changes in behavior observed in captive animals may have even more profound or long term consequences in the wild. This study cannot suggest a critical distance between noise and dolphins, however, it can provide suggestions to future geophysical surveyors and effect assessors.

REPORT OF THE SEVENTH MEETING OF THE SCIENTIFIC COMMITTEE OF ACCOBAMS (2011) ACCOBAMS-SC7/2011/Doc29

http://www.accobams.org/index.php?option=com_content&view=article&id=1107:seventh-meeting-of-the-scientific-committee&catid=52:meetings-of-the-sc&Itemid=79

51. Ana Cañadas presented SC7_Doc15. The modelling initiative is a collaborative effort with all those holding suitable effort and sightings data in the area. This work has used habitat preference modelling as tool for data analysis. The approach uses physical and environmental data to help explain variation in cetacean distribution and predict areas that are important for target species. A list with all data contributors to this initiative was provided.

52. The best model selected three covariates: depth, average sea surface temperature, and latitude, with a total deviance explained of 57.8%. Maps with the predicted relative densities of beaked whales in the Mediterranean were presented. The best model highlights three areas with the highest relative density of beaked whales: the Alboran Sea, the Northern Ligurian Sea, and the Hellenic Trench and north of Crete. In addition, the Tyrrhenian Sea, the Southern Adriatic Sea and some areas to the north of the Balearic Islands and south of Sicily show relatively high predicted density compared to the rest of the Mediterranean. Nevertheless, it is very important to highlight that this analysis used a compilation of 21 years of very heterogeneous data. In particular, there are large areas where there are little or no data. Therefore, this analysis should be considered as a preliminary exploration and the results should be taken with considerable caution.

53. Giuseppe Notarbartolo di Sciara remarked that the result of five years of work based on a large base of data should be considered sufficiently robust to provide recommendations that can be used for management and mitigation purposes. He further suggested that a Working Group be created to formulate the consequences of Ana Cañadas‟ report.

54. After having met, the Working Group proposed the following:

a. a large portion of slope and deep waters (deeper than 600 m) throughout the Mediterranean contained suitable Ziphius habitat;

b. based on existing knowledge of noise disturbance thresholds, beaked whales should not be exposed to received levels greater than SPL 140 dB re 1 µPa @ 1 m;

c. it was therefore recommended to apply a safety buffer around the preferred habitat mentioned in a) so that the threshold would not be exceeded.

55. The Scientific Committee approved the outcome of the Working Group.

56. Ana Cañadas informed the Committee that after consultation with all the data providers, she was going to produce a final report inclusive of the Scientific Committee recommendations, for wider circulation, as appropriate.

Michel André, Marta Solé, Marc Lenoir, Mercè Durfort, Carme Quero, Alex Mas, Antoni Lombarte, Mike van der Schaar, Manel López-Bejar, Maria Morell, Serge Zaugg, and Ludwig Houégnigan. 2011. Low-frequency sounds induce acoustic trauma in cephalopods. Frontiers in Ecology and the Environment

http://www.esajournals.org/doi/abs/10.1890/100124?prevSearch=%5Ball%3A+Andr%C3%A9%5D+AND+%5Bauthor%3A+Andr%C3%A9%5D+AND+%5Babstract%3A+noise%5D&searchHistoryKey=

There is currently relatively little information on how marine organisms process and analyze sound, making assessments about the impacts of artificial sound sources in the marine environment difficult. However, such assessments have become a priority because noise is now considered as a source of pollution that increasingly affects the natural balance of the marine ecosystems. We present the first morphological and ultrastructural evidence of massive acoustic trauma, not compatible with life, in four cephalopod species subjected to low-frequency controlled-exposure experiments. Exposure to low-frequency sounds resulted in permanent and substantial alterations of the sensory hair cells of the statocysts, the structures responsible for the animals' sense of balance and position. These results indicate a need for further environmental regulation of human activities that introduce high-intensity, low-frequency sounds in the world's oceans.

2010

Mann D, Hill-Cook M, Manire C, Greenhow D, Montie E, et al. (2010) Hearing Loss in Stranded Odontocete Dolphins and Whales. PLoS ONE 5(11): e13824. doi:10.1371/journal.pone.0013824

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0013824

The causes of dolphin and whale stranding can often be difficult to determine. Because toothed whales rely on echolocation for orientation and feeding, hearing deficits could lead to stranding. We report on the results of auditory evoked potential measurements from eight species of odontocete cetaceans that were found stranded or severely entangled in fishing gear during the period 2004 through 2009. Approximately 57% of the bottlenose dolphins and 36% of the rough-toothed dolphins had significant hearing deficits with a reduction in sensitivity equivalent to severe (70–90 dB) or profound (>90 dB) hearing loss in humans. The only stranded short-finned pilot whale examined had profound hearing loss. No impairments were detected in seven Risso's dolphins from three different stranding events, two pygmy killer whales, one Atlantic spotted dolphin, one spinner dolphin, or a juvenile Gervais' beaked whale. Hearing impairment could play a significant role in some cetacean stranding events, and the hearing of all cetaceans in rehabilitation should be tested.

Christina Mueller-Blenkle, Peter K. McGregor, Andrew B. Gill, Mathias H. Andersson, Julian Metcalfe, Victoria Bendall, Peter Sigray, Daniel Wood, Frank Thomsen (2010) EFFECTS OF PILE-DRIVING NOISE ON THE BEHAVIOUR OF MARINE FISH COWRIE Ref: Fish 06-08 / Cefas Ref: C3371 Technical Report 31th March 2010

http://www.offshorewindfarms.co.uk/Assets/COWRIE%20FISH%2006-08_Technical%20report_Cefas_31-03-10.pdf

Studies on the effects of offshore wind farm construction on marine life have so far focussed on behavioural reactions in porpoises and seals. The effects on fish have only very recently come into the focus of scientists, regulators and stakeholders. Pile-driving noise during construction is of particular concern as the very high sound pressure levels could potentially prevent fish from reaching breeding or spawning sites, finding food, and acoustically locating mates. This could result in longterm effects on reproduction and population parameters. Further, avoidance reactions might result in displacement away from potential fishing grounds and lead to reduced catches. However, reaction thresholds and therefore the impacts of pile-driving on the behaviour of fish are completely unknown. ……

Authors J.L. Michael, SPE, Chevron; L. Notor, SPE, ConocoPhillips Company; J. Campbell, SPE, OGP; D. Hedgeland, SPE, PGS; M. Jenkerson, ExxonMobil; R. Melton, SPE, ExxonMobil Upstream Research Company; R.D. Tait, SPE, ExxonMobil Production Company; S. Tsoflias SPE, IAGC (2010) Title Joint Industry Programme on Exploration and Production Sound and Marine Life: Update on Research Progress. Source SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, 12-14 April 2010, Rio de Janeiro, Brazil Copyright 2010. Society of Petroleum Engineers

http://www.onepetro.org/mslib/servlet/onepetropreview?id=SPE-127092-MS&soc=SPE

A group of 14 oil and gas companies and the International Association of Geophysical Contractors (IAGC) through the International Association of Oil and Gas Producers (OGP) have been funding the Joint Industry Programme on Exploration and Production (E&P) Sound and Marine Life (JIP). The JIP funds research to reduce the uncertainty around the risk of negatively impacting marine animal populations during E&P activities. While there is little to no scientific evidence showing significant negative impacts, there are gaps in scientific knowledge that create uncertainty in industry risk assessments. In the absence of complete data, environmental regulators may, and do impose, conservative restrictions on E&P activities aimed to prevent or mitigate the possibility of significant impacts. .....

Helen Baileya, , , Bridget Seniora, Dave Simmonsb, Jan Rusinb, Gordon Pickenc and Paul M. Thompsona (2010) Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. Marine Pollution Bulletin. Volume 60, Issue 6, June 2010, Pages 888-897

www.sciencedirect.com

Marine renewable developments have raised concerns over impacts of underwater noise on marine species, particularly from pile-driving for wind turbines. Environmental assessments typically use generic sound propagation models, but empirical tests of these models are lacking. In 2006, two 5 MW wind turbines were installed off NE Scotland. The turbines were in deep (>40 m) water, 25 km from the Moray Firth Special Area of Conservation (SAC), potentially affecting a protected population of bottlenose dolphins. We measured pile-driving noise at distances of 0.1 (maximum broadband peak to peak sound level 205 dB re 1 µPa) to 80 km (no longer distinguishable above background noise). These sound levels were related to noise exposure criteria for marine mammals to assess possible effects. For bottlenose dolphins, auditory injury would only have occurred within 100 m of the pile-driving and behavioural disturbance, defined as modifications in behaviour, could have occurred up to 50 km away.

Katz, Richard A. ; Cipriano, Nicholas J. ; Pearson, David J. ; Dunkleberger, Steve R. (2010) The Decibel Report: Acoustic Sound Measurement Modeling and the Effects of Sonar on Marine Mammals. NAVAL UNDERSEA WARFARE CENTER DIV NEWPORT RI Accession Number : ADA530137

http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA530137&Location=U2&doc=GetTRDoc.pdf

Abstract : This report is an authoritative and comprehensive explanation of sound-level quantities, metrics, and sonar models; its purpose is to provide best available science to acoustics and marine biology subject matter experts, sonar and environmental planners, and policy decision-makers so they can be better informed of the terminology, usage, and practices undertaken for modeling underwater sound energy effects pertinent to U.S. Naval sonar operations and the marine habitat.

Sarah J. Dolmana, Eunice Pinna, Robert J. Reida, Jason P. Barleya, Rob Deavillea, Paul D. Jepsona, Mick O'Connella, Simon Berrowa, Rod S. Penrosea, Peter T. Stevicka, Susannah Calderana, Kevin P. Robinsona, Robert L. Brownell Jra and Mark P. Simmondsa (2010) A note on the unprecedented strandings of 56 deep-diving whales along the UK and Irish coast. Marine Biodiversity Records (2010), 3: e16

http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=7285852

In the first seven months of 2008, eighteen Cuvier's beaked whales (Ziphius cavirostris), four Sowerby's beaked whales (Mesoplodon bidens), five unidentified beaked whales and twenty-nine long-finned pilot whales (Globicephala melas) were reported stranded in the UK and Ireland. Decomposition of those animals investigated puts the predicted time of death at mid-January. Concerns that an unusual mortality event had taken place prompted further investigations. Most carcasses were too decomposed for necropsy. A summary of findings is presented here. Although the initial stranding of five Cuvier's beaked whales in Scotland shared some similarities with atypical mass stranding events linked in time and space to mid-frequency naval sonars, there were two important differences with the remaining strandings during this period. First, the geographical range of the event was very wide and second, the strandings occurred over a prolonged period of several months. Both of these factors could be related to the fact that the mortalities occurred offshore and the carcasses drifted ashore. The cause(s) of this high number of strandings of mixed offshore cetacean species during this period remain undetermined

James J. Finneran; Donald A. Carder; Carolyn E. Schlundt; Randall L. Dear (2010) Temporary threshold shift in a bottlenose dolphin (Tursiops truncatus) exposed to intermittent tones. J. Acoust. Soc. Am. / Volume 127 / Issue 5 / BIOACOUSTICS

http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JASMAN000127000005003267000001&idtype=cvips&gifs=yes&ref=no

Temporary threshold shift in a bottlenose dolphin (Tursiops truncatus) exposed to intermittent tonesTemporary threshold shift (TTS) was measured in a bottlenose dolphin exposed to a sequence of four 3-kHz tones with durations of 16 s and sound pressure levels (SPLs) of 192 dB re 1 μPa. The tones were separated by 224 s of silence, resulting in duty cycle of approximately 7%. The resulting growth and recovery of TTS were compared to experimentally measured TTS in the same subject exposed to single, continuous tones with similar SPLs. The data confirm the potential for accumulation of TTS across multiple exposures and for recovery of hearing during the quiet intervals between exposures. The degree to which various models could predict the growth of TTS across multiple exposures was also examined.

Melcon ML, Cummins AJ, Wiggins SM, Hildebrand JA (2010) Assessing the effects of mid-frequency sonar on cetaceans in Southern California. Canadian Acoustics 38:24-25

Mid-frequency active sonar (MFA) is regularly used during naval exercises to provide an acoustic image of subsurface features, including natural and anthropogenic targets. Because MFA is often operated at high intensities, its sounds can be heard for thousands of square kilometers. MFA signal characteristics can vary considerably over its frequency band, 1-10 kHz, which coincidently happens to be in the audible band for most, if not all, marine mammal species. Over the past decade, correlations have been found between MFA and anomalous mass standings of beaked whales (Cox et al., 2006). However, the mechanisms by which MFA affects beaked whales are not well understood.

Thompson PM, Lusseau D, Barton T, Simmons D, Rusin J, Bailey H (2010) Assessing the responses of coastal cetaceans to the construction of offshore wind turbines. Marine Pollution Bulletin 60:1200-1208

The expansion of offshore renewables has raised concerns over potential disturbance to coastal cetaceans. In this study, we used passive acoustic monitoring to assess whether cetaceans responded to pile-driving noise during the installation of two 5MW offshore wind turbines off NE Scotland in 2006. Monitoring was carried out at both the turbine site and a control site in 2005, 2006 and 2007. Harbour porpoises occurred regularly around the turbine site in all years, but there was some evidence that porpoises did respond to disturbance from installation activities. We use these findings to highlight how uncertainty over cetacean distribution and the scale of disturbance effects constrains opportunities for B-A-C-I studies. We explore alternative approaches to assessing the impact of offshore wind farm upon cetaceans, and make recommendations for the research and monitoring that will be required to underpin future developments

Faerber, M.M., and Baird, R.W. 2010. Does a lack of observed beaked whale strandings in military exercise areas mean no impacts have occurred? A comparison of stranding and detection probabilities in the Canary and main Hawaiian Islands. Mar. Mamm. Sci. 26, 602–613

http://onlinelibrary.wiley.com/doi/10.1111/j.1748-7692.2010.00370.x/abstract

Anthropogenic activities must be monitored to determine effects on marine mammal species, but the difficulty lies in how to measure impact. Mass strandings of beaked whales have occurred in association with naval exercises, with two species most affected, Cuvier's (Ziphius cavirostris) and Blainville's (Mesoplodon densirostris) beaked whales. Six such events have occurred in the Canary Islands but there have been no reported mass strandings in Hawai'i. We assess the hypothesis that factors that influence the likelihood of strandings occurring and/or being detected differ between the Canary and main Hawaiian Islands, such that beaked whale stranding/detection probabilities will be lower in Hawai'i. On an archipelago-wide basis, nearshore bathymetric comparisons indicate that the Canaries have a

greater proportion and a total greater amount of appropriate beaked whale habitat closer to shore, with a steeper slope. Hawaiian shorelines are more dominated by steep cliffs, human population density is much lower, and human population per kilometer of shoreline is 53% lower than in the Canaries. All of these factors suggest that there is a higher probability of a carcass washing onshore and being detected in the Canary Islands. It cannot be concluded that the lack of mass strandings in Hawai'i is evidence of no impact.

General publication which should be considered

2012

Interesting book:

Popper, Arthur N.; Hawkins, Anthony (Eds.) (2012) The effects of Noise on Aquatic Life (Springer)

These proceedings are the extended abstracts of the papers presented at the 2010 Second International Meeting on the Effects of Noise on Aquatic Life that took place in August in Cork, Ireland. The meeting brought together 248 scientists, regulators, and representatives from industry and environmental groups, representing 21 countries from all continents, to hear papers and discuss a broad range of topics focused on underwater sound and its effects on organisms living in the aquatic environment. This meeting followed from the immensely successful first conference that took place in 2007 in Nyborg, Denmark.

http://www.springer.com/biomed/neuroscience/book/978-1-4419-7310-8?cm_mmc=Google-_-Book%20Search-_-Springer-_-0

2011

Andrew L.R. Jackson (2011) Renewable energy vs. biodiversity: Policy conflicts and the future of nature conservation. Global Environmental Change Vol 4/2 pp 1196-1208

The European Union's (EU) network of nature conservation areas – Natura 2000 – covers almost 18% of EU territory, and is subject to strict legal protection, which is enforced by the European Commission, a supranational authority. Given the Natura 2000 network's size, conflicts between Natura 2000 and renewable energy projects are inevitable, particularly as countries push to meet their 2020 energy and emissions reduction targets by pursuing more – and larger – renewable energy projects. Focusing on two cases in the renewable energy sector – a hydroelectric dam in Portugal's Sabor valley, and a large tidal barrage in the UK's Severn estuary – this article shows that the EU's strict biodiversity protection regime could necessitate the rejection of many large renewable energy projects. That is, it may not be possible as a matter of EU law for national authorities to grant permission for such projects. The potential for such difficulties will be shown to be highly visible to policymakers, and could, this article argues, trigger negative impacts in terms of the rule of law, and negative feedbacks on nature conservation policies in the EU and, by way of precedent, globally. The legal issues presented here should not, this article argues, be regarded as insurmountable problems, nor as a trigger for reforms aimed at weakening biodiversity protections. Rather, these issues are better regarded as an opportunity for an open, informed, global debate regarding the relationship between biodiversity and climate change policies, and the hierarchy, if any, between them.

http://www.sciencedirect.com/science/article/pii/S0959378011001063

Conservation plan for the Harbour Porpoise Phocoena phocoena in The Netherlands: towards a avourable Kees (C.J.) Camphuysen & Marije L. Siemensma conservation status

Camphuysen C.J. & M.L. Siemensma (2011). Conservation plan for the Harbour Porpoise Phocoena phocoena in The Netherlands: towards a favourable conservation status. NIOZ Report 2011-07, Royal Netherlands Institute for Sea Research,Texel. Conservation plan for the Harbour Porpoise Phocoena phocoena in The Netherlands: towards a favourable conservation status

http://www.nioz.nl/public/nioz_reports/nioz-report_2011-7.pdf

R. Brabant*, S. Degraer & B. Rumes Offshore wind energy development in the Belgian part of the North Sea & anticipated impacts: an update
http://www.vliz.be/imisdocs/publications/227494.pdf

Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus. Evidence that ship noise increases stress in right whales. Proc. R. Soc. B published online 8 February 2012, doi: 10.1098/rspb.2011.2429

Baleen whales (Mysticeti) communicate using low-frequency acoustic signals. These long-wavelength sounds can be detected over hundreds of kilometres, potentially allowing contact over large distances. Low-frequency noise from large ships (20–200 Hz) overlaps acoustic signals used by baleen whales, and increased levels of underwater noise have been documented in areas with high shipping traffic. Reported responses of whales to increased noise include: habitat displacement, behavioural changes and alterations in the intensity, frequency and intervals of calls. However, it has been unclear whether exposure to noise results in physiological responses that may lead to significant consequences for individuals or populations. Here, we show that reduced ship traffic in the Bay of Fundy, Canada, following the events of 11 September 2001, resulted in a 6 dB decrease in underwater noise with a significant reduction below 150 Hz. This noise reduction was associated with decreased baseline levels of stress-related faecal hormone metabolites (glucocorticoids) in North Atlantic right whales (Eubalaena glacialis). This is the first evidence that exposure to low-frequency ship noise may be associated with chronic stress in whales, and has implications for all baleen whales in heavy ship traffic areas, and for recovery of this endangered right whale population.

http://rspb.royalsocietypublishing.org/content/early/2012/02/01/rspb.2011.2429.abstract

Alexander Gillespie. Noise Pollution, the Oceans, and the Limits of International Law. *Yearbook of International Environmental Law* (2011) doi: 10.1093/yiel/yvr005

(Introduction)The oceans of the world are becoming increasingly noisy. The primary sources of the new noise are commercial shipping, seismic surveys, and military sonar. Many of these sources of noise appear to have a detrimental impact upon many species in the ocean. Although the scientific questions are being resolved, the legal frameworks through which this problem must be dealt are already mapped, due to the fact that the UN Convention on the Law of the Sea (UNCLOS) is very clear on both the principles to be applied and how it is to be done.1 In this regard, the framework of UNCLOS neatly divides up the areas of concern of commercial shipping to the International Maritime Organization (IMO); of seismic testing to the sovereign state within its exclusive economic zone and the International Seabed Authority (ISA); and of pollution caused by military vessels to sovereign immunity. The problem that avails from this scheme is that none of these regimes is adequately addressing the difficulty at hand.

http://www.austlii.edu.au/au/journals/MelbJIL/2001/12.html

Irini Papanicolopulu. On the interaction between law and science: considerations on the ongoing process of regulating underwater acoustic pollution. Aegean Review of the Law of the Sea and Maritime Law, Volume 1, Number 2, 247-265, DOI: 10.1007/s12180-011-0018-6

Scientific and technological development necessitates often legal regulation, to be achieved through an interaction between science and law during the decision-making process. Taking as an example the case of underwater noise pollution, the examination of which is underway in many international organisations with a view towards its regulation, the article proposes to comment upon some aspects of this interaction. It is finally submitted that law provides sufficient legal principles and institutionalised frameworks for cooperation, which however have not been sufficiently put in use so far.

http://ilreports.blogspot.com/2011/09/new-issue-aegean-review-of-law-of-sea.html

Jonathan A. David. Theoretical approach to estimating the induction of hearing impairment in bottlenose dolphins by radiated leisure boat noise. Journal of the Marine Biological Association of the United Kingdom, FirstView Article : pp 1-6. DOI: 10.1017/S002531541100110X. Published online: 30 August 2011

Coastal waters are being subjected to underwater noise generated by increasing numbers of leisure and tour boats. Such noise has the potential to impair the hearing of neighbouring bottlenose dolphins, particularly as the noise from several distributed boats could summate at the point of reception. This potential has been assessed by comparing small boat noise, recorded over a range of 8–532 m, with noise that is known to induce hearing impairment in the form of a temporary threshold shift (TTS) or permanent threshold shift (PTS). Extrapolation of broadband boat noise levels yielded a minimum source sound pressure level of 156 dB re 1µPa at 1 m. An equal-energy model for TTS-onset predicted that boat noise could induce a TTS after 1 hour's exposure at 1.3 m and after 8 hours' exposure at 2.3 m. These distances increased with additional adjacent boats. Leisure boats are unlikely to induce a PTS, even at close range.

http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=8363016&fulltextType=RA&fileId=S002531541100110X

M. J. Witt, E. V. Sheehan, S. Bearhop, A. C. Broderick, D. C. Conley, S. P. Cotterell, E. Crow, W. J. Grecian, C. Halsband, D. J. Hodgson, P. Hosegood, R. Inger, P. I. Miller, D. W. Sims, R. C. Thompson, K. Vanstaen, S. C. Votier, M. J. Attrill and B. J. Godley. Assessing wave

energy effects on biodiversity: the Wave Hub experience. *Phil. Trans. R. Soc. A* 28 January 2012 vol. 370 no. 1959 502-529. doi: 10.1098/rsta.2011.0265

Marine renewable energy installations harnessing energy from wind, wave and tidal resources are likely to become a large part of the future energy mix worldwide. The potential to gather energy from waves has recently seen increasing interest, with pilot developments in several nations. Although technology to harness wave energy lags behind that of wind and tidal generation, it has the potential to contribute significantly to energy production. As wave energy technology matures and becomes more widespread, it is likely to result in further transformation of our coastal seas. Such changes are accompanied by uncertainty regarding their impacts on biodiversity. To date, impacts have not been assessed, as wave energy converters have yet to be fully developed. Therefore, there is a pressing need to build a framework of understanding regarding the potential impacts of these technologies, underpinned by methodologies that are transferable and scalable across sites to facilitate formal meta-analysis. We first review the potential positive and negative effects of wave energy generation, and then, with specific reference to our work at the Wave Hub (a wave energy test site in southwest England, UK), we set out the methodological approaches needed to assess possible effects of wave energy on biodiversity. We highlight the need for national and international research clusters to accelerate the implementation of wave energy, within a coherent understanding of potential effects—both positive and negative.

http://rsta.royalsocietypublishing.org/content/370/1959/502.short

Risch D, Corkeron PJ, Ellison WT, Van Parijs SM (2012) Changes in Humpback Whale Song Occurrence in Response to an Acoustic Source 200 km Away. PLoS ONE 7(1): e29741. doi:10.1371/journal.pone.0029741

The effect of underwater anthropogenic sound on marine mammals is of increasing concern. Here we show that humpback whale (*Megaptera novaeangliae*) song in the Stellwagen Bank National Marine Sanctuary (SBNMS) was reduced, concurrent with transmissions of an Ocean Acoustic Waveguide Remote Sensing (OAWRS) experiment approximately 200 km away. We detected the OAWRS experiment in SBNMS during an 11 day period in autumn 2006. We compared the occurrence of song for 11 days before, during and after the experiment with song over the same 33 calendar days in two later years. Using a quasi-Poisson generalized linear model (GLM), we demonstrate a significant difference in the number of minutes with detected song between periods and years. The lack of humpback whale song during the OAWRS experiment was the most substantial signal in the data. Our findings demonstrate the greatest published distance over which anthropogenic sound has been shown to affect vocalizing baleen whales, and the first time that active acoustic fisheries technology has been shown to have this effect. The suitability of Ocean Acoustic Waveguide Remote Sensing technology for *in-situ*, long term monitoring of marine ecosystems should be considered, bearing in mind its possible effects on non-target species, in particular protected species.

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0029741

Ian H. McQuinn, Véronique Lesage, Dominic Carrier, Geneviève Larrivée, Yves Samson, Sylvain Chartrand, Robert Michaud, and James Theriault . A threatened beluga (*Delphinapterus leucas*) population in the traffic lane: Vessel-generated noise characteristics of the Saguenay-St. Lawrence Marine Park, Canada. J. Acoust. Soc. Am. Volume 130, Issue 6, pp. 3661-3673 (2011); (13 pages)

The threatened resident beluga population of the St. Lawrence Estuary shares the Saguenay-St. Lawrence Marine Park with significant anthropogenic noise sources, including marine commercial traffic and a well-established, vessel-based whale-watching industry. Frequency-dependent (FD) weighting was used to approximate beluga hearing sensitivity to determine how noise exposure varied in time and space at six sites of high beluga summer residency. The relative contribution of each source to acoustic habitat degradation was estimated by measuring noise levels throughout the summer and noise signatures of typical vessel classes with respect to traffic volume and sound propagation characteristics. Rigid-hulled inflatable boats were the dominant noise source with respect to estimated beluga hearing sensitivity in the studied habitats due to their high occurrence and proximity, high correlation with site-specific FD-weighted sound levels, and the dominance of mid-frequencies (0.3–23 kHz) in their noise signatures. Median C-weighted sound pressure level (SPLRMS) had a range of 19 dB re 1 µPa between the noisiest and quietest sites. Broadband SPLRMS exceeded 120 dB re 1 µPa 8–32% of the time depending on the site. Impacts of these noise levels on St. Lawrence beluga will depend on exposure recurrence and individual responsiveness.

http://asadl.org/jasa/resource/1/jasman/v130/i6/p3661_s1?isAuthorized=no

Thomsen, Frank. Cetacean Stock Assessments in Relation to Exploration and Production Industry Activity and Other Human Pressures: Review and Data Needs

(Herkunft/citation unklar)

The impacts of manmade underwater sound on cetaceans have become an important environmental issue. A number of studies have documented effects on individuals such as behavioural response; masking of biologically relevant signals; and hearing loss, either temporary or permanent (reviews by Richardson et al., 1995; Southall et al., 2007). Little is known, however, about the population-level consequences of acoustic impacts. Methodologies addressing this issue, such as risk-based and cumulative impact assessments, are still in their infancy (e.g., National Research Council [NRC], 2005; Boyd et al., 2008; Wright, 2009). There is also limited information on levels of human activities generating sound and uncertainties in cetacean stock assessments that hamper quantitative investigations. Yet, sound generating industries are active in many parts of the world's oceans and, therefore, qualitative assessments could provide a first step in managing potential conflicts between industry sectors generating sound and cetacean conservation. The Exploration and Production industry (E&P industry) generates underwater sound potentially affecting individual cetaceans, with most concerns expressed about the effects of seismic surveys (review by OSPAR, 2009). However, the relationship between E&P industry activities and trends in cetacean stocks has rarely been investigated. We provide a global overview of E&P industries and cetacean stock data in order to identify hot spots for more detailed investigations. Thus, in four case studies, we quantified the E&P industry activity in a specific region, investigated the status and trends of seven cetacean stocks therein, and assessed other factors presumably influencing the populations in question.

http://readperiodicals.com/201101/2310726611.html

W.T. ELLISON, B.L. SOUTHALL, C.W. CLARK, A.S. FRANKEL. A New Context-Based Approach to Assess Marine Mammal Behavioral Responses to Anthropogenic Sounds. Conservation Biology, Volume 26, Issue 1, pages 21–28, February 2012.

Acute effects of anthropogenic sounds on marine mammals, such as from military sonars, energy development, and offshore construction, have received considerable international attention from scientists, regulators, and industry. Moreover, there has been increasing recognition and concern about the potential chronic effects of human activities (e.g., shipping). It has been demonstrated that increases in human activity and background noise can alter habitats of marine animals and potentially mask communications for species that rely on sound to mate, feed, avoid predators, and navigate. Without exception, regulatory agencies required to assess and manage the effects of noise on marine mammals have addressed only the acute effects of noise on hearing and behavior. Furthermore, they have relied on a single exposure metric to assess acute effects: the absolute sound level received by the animal. There is compelling evidence that factors other than received sound level, including the activity state of animals exposed to different sounds, the nature and novelty of a sound, and spatial relations between sound source and receiving animals (i.e., the exposure context) strongly affect the probability of a behavioral response. A more comprehensive assessment method is needed that accounts for the fact that multiple contextual factors can affect how animals respond to both acute and chronic noise. We propose a three-part approach. The first includes measurement and evaluation of context-based behavioral responses of marine mammals exposed to various sounds. The second includes new assessment metrics that emphasize relative sound levels (i.e., ratio of signal to background noise and level above hearing threshold). The third considers the effects of chronic and acute noise exposure. All three aspects of sound exposure (context, relative sound level, and chronic noise) mediate behavioral response, and we suggest they be integrated into ecosystem-level management and the spatial planning of human offshore activities

http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2011.01803.x/full

H J Lindeboom, H J Kouwenhoven, M J N Bergman, S Bouma, S Brasseur, R Daan, R C Fijn, D de Haan, S Dirksen, R van Hal, R Hille Ris Lambers, R ter Hofstede, K L Krijgsveld, M Leopold and M Scheidat. Short-term ecological effects of an offshore wind farm in the Dutch coastal zone; a compilation. *Environ. Res. Lett.* 6 035101 doi:10.1088/1748-9326/6/3/035101

The number of offshore wind farms is increasing rapidly, leading to questions about the environmental impact of such farms. In the Netherlands, an extensive monitoring programme is being executed at the first offshore wind farm (Offshore Windfarm Egmond aan Zee, OWEZ). This letter compiles the short-term (two years) results on a large number of faunal groups obtained so far. Impacts were expected from the new hard substratum, the moving rotor blades, possible underwater noise and the exclusion of fisheries. The results indicate no short-term effects on the benthos in the sandy area between the generators, while the new hard substratum of the monopiles and the scouring protection led to the establishment of new species and new fauna communities. Bivalve recruitment was not impacted by the OWEZ wind farm. Species composition of recruits in OWEZ and the surrounding reference areas is correlated with mud content of the sediment and water depth irrespective the presence of OWEZ. Recruit abundances in OWEZ were correlated with mud content, most likely to be attributed not to the presence of the farm but to the absence of fisheries. The fish community was highly dynamic both in time and space. So far, only minor effects upon fish assemblages especially near the monopiles have been observed. Some fish species, such as cod, seem to find shelter inside the farm. More porpoise clicks were recorded inside the farm than in the reference areas outside the farm. Several bird species seem to avoid the park while others are indifferent or are even attracted. The effects of the wind farm on a highly variable ecosystem are described. Overall, the OWEZ wind farm acts as a new type of habitat with a higher biodiversity of benthic organisms, a possibly increased use of the area by the benthos, fish, marine mammals and some bird species and a decreased use by several other bird species.

http://iopscience.iop.org/1748-9326/6/3/035101

Boyd , I , Frisk , G , Urban , E , Tyack , P , Ausubel , J , Seeyave , S , Cato , D , Southall , B , Weise , M , Andrew , R , Akamatsu , T , Dekeling , R , Erbe , C , Farmer , D , Gentry , R , Goss , T , Hawkins , A , Li , F , Metcalf , K , Miller , J , Moretti , D , Rodrigo , C & Shinke , T 2011 , ' An International Quiet Oceans Experiment ' , Oceanography , vol 24 , no. 2 , pp. 78-85 .

The effect of noise on marine life is one of the big unknowns of current marine science. Considerable evidence exists that the human contribution to ocean noise has increased during the past few decades: human noise has become the dominant component of marine noise in some regions, and noise is directly correlated with the increasing industrialization of the ocean. Sound is an important factor in the lives of many marine organisms, and theory and increasing observations suggest that human noise could be approaching levels at which negative effects on marine life may be occurring. Certain species already show symptoms of the effects of sound. Although some of these effects are acute and rare, chronic sublethal effects may be more prevalent, but are difficult to measure. We need to identify the thresholds of such effects for different species and be in a position to predict how increasing anthropogenic sound will add to the effects. To achieve such predictive capabilities, the Scientific Committee on Oceanic Research (SCOR) and the Partnership for Observation of the Global Oceans (POGO) are developing an International Quiet Ocean Experiment (IQOE), with the objective of coordinating the international research community to both quantify the ocean soundscape and examine the functional relationship between sound and the viability of key marine organisms. SCOR and POGO will convene an open science meeting to gather community input on the important research, observations, and modeling activities that should be included in IQOE.

http://research-repository.st-andrews.ac.uk/handle/10023/1909

Peter L. Tyack. Using Digital Acoustic Recording Tags to Detect Marine Mammals on Navy Ranges and Study their Responses to Naval Sonar. SERDP Project RC-1539. Contract #W912HQ-06-C0054

This project developed methods and tools to monitor cetaceans including species of beaked whale that mass strand during some naval sonar exercises, defined the acoustic exposures that start to pose a risk, and developed methods to study how beaked and other whales respond to sonar and other sounds. The objectives included the following:
-Quantify the probability of detecting beaked whales by listening to the vocalizations of tagged whales using hydrophones on a navy underwater range
- Develop methods and conduct studies on the effect of sonar and other sounds on beaked and other whales. Define exposure parameters that pose risk to beaked whales. Test whether this risk extends to other signals and other species
The technical approaches were:
-Work with NUWC to locate beaked and other whales, tag them, and compare tag data on vocalizations with detections on range hydrophones to estimate probability of detection as a function of range and orientation of the tagged whale.
-Develop tagging techniques and field efforts to enable observational techniques or experiments that use the tag to monitor reactions of marine mammals to exposures of manmade noise.
-Develop, bench test, and build a new tag design and perform field evaluation of the new tags
All of these objectives were achieved using the technical approaches listed. In collaboration with David Moretti's group at NUWC-Newport, we validated the probability of detecting beaked whale clicks from Blainville's beaked whales tagged on the AUTEC range as a function of range and aspect. SERDP funded work also provided the basis for studying passive acoustic detection of Cuvier's beaked whale. These results have formed the basis of major advances in development by the NOPP-funded DECAF project of methods to estimate the absolute density and number of beaked whales based on passive acoustic detection of their vocalizations.
http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA544410

***Mohammad Javad Deylam, Mohammad Ali Gheraat, Nasser Naghdi, Leila Eidi Abarghani.* Impairment of spatial performance by continuous intensive noise: a behavioral view. Psychology & Neuroscience, Vol 4, No 3 (2011)**

A wide range of animal and human investigations have tested the neurobiological and immunological aspects of noise. Few studies, however, have explored the behavioral characteristics of noise on neuromotor movements. To examine this correlation, we tested the effects of continuous intensive noise on retention and contextual transfer in a spatial memory task in adult male rats. The natural noise was recorded in a football stadium and set at high (HI), moderate (MI), and low (LI) intensities, levels corresponding to 86-90, 64-68, and 52-54 A-weighted decibels (dbA), respectively. Rats were trained in a Morris water maze for 3 consecutive days. On day 4, visible and probe tests were conducted under the same intensities. Retention was evaluated on day 7 with high-intensity noise exposure. The contextual transfer test was held on day 8 after exposure to 30-min high-intensity noise. The escape latency and distance traveled were recorded and used for subsequent analyses. Our results showed significant increases in latency and distance traveled, attributable to increasing the noise intensity during the acquisition period. Additionally, performance in the LI group was significantly impaired in the retention test at the high intensity. In the contextual transfer test, results showed no significant increase except in the LI group, whereas a higher latency and distance traveled were found in the HI group. High-intensity noise appeared to damage the learning process. However, because the most robust results were found in the MI group, training with moderate-intensity noise can promote better performance under continuous high-intensity noise.

http://www.psycneuro.org/index.php/psycneuro/article/viewArticle/185

Randall Reeves, Cheryl Rosa, J.Craig George, Gay Sheffield, Michael Moore. Implications of Arctic industrial growth and strategies to mitigate future vessel and fishing gear impacts on bowhead whales. Marine Policy, Volume 36, Issue 2, March 2012, Pages 454–462.

The objective of this paper was to investigate and illustrate how insights gained from experience managing human activities in order to protect North Atlantic right whales (*Eubalaena glacialis*) along the heavily industrialized east coast of North America might be applied in the Arctic, where bowhead whales (*Balaena mysticetus*) face some of the same risks as right whales. The reduced extent and thickness of sea ice and the resultant longer open-water season have major, complex implications for the Arctic marine ecosystem. Increased maritime ship traffic and commercial fishing in the Arctic are bound to affect bowheads and Native (indigenous) hunting communities who depend on whales for subsistence and cultural identity. Bowheads and right whales were greatly depleted by commercial whaling in the 19th and early 20th centuries. While the Western Arctic bowhead population has been recovering steadily in recent decades, North Atlantic right whales remain highly endangered because of persistent lethal and sublethal vessel strikes and frequent entanglement in commercial fishing gear. Entanglement can be transitory or persistent, with debilitation lasting for months before the animal finally succumbs. Vessel strike and fishing gear trauma has been documented in bowheads, but at a much lower rate than in right whales. Initiatives intended to mitigate the impacts of ship traffic on North Atlantic right whales have included speed limits and routing changes. Those meant to reduce the incidence and severity of entanglements include the modification of gear design and gear deployment practices. Management measures need to be considered in advance in the Arctic in order to minimize the risks to bowhead whales as shipping and industrial fishing expand in the Arctic with ice retreat.

http://www.sciencedirect.com/science/article/pii/S0308597X11001400

Alvin Aaden Yim-Hol Chan, Daniel T. Blumstein. Attention, noise, and implications for wildlife conservation and management. Applied Animal Behaviour Science, Volume 131, Issues 1–2, April 2011, Pages 1–7.

Anthropogenic stimuli are often viewed as disturbances that directly interfere with signal processing or communication, or directly harm animals. However, such sounds may also distract individuals and thus potentially interfere with their ability to make biologically important decisions about food selection, mate selection, and predator detection. This is because all of these decisions require animals to focus their attention on these tasks and the attention allocated to perceived stimuli is limited. We review the ways that attention is studied, the diversity of taxa in which this cognitive process has been studied, and how stimuli from one modality may interfere with attentional processes in another modality. Such distraction may increase the vulnerability of prey to predators and thus influence predation rates and, ultimately, both the population size, and the effective population size (through differential mortality). Recognizing that distraction is likely to be widespread is the first step towards managing it for wildlife conservation and the management of problem animals.

http://www.sciencedirect.com/science/article/pii/S0168159111000268

Lloyd, Thomas P., Turnock, Stephen R. and Humphrey, Victor F. (2011) Modelling techniques for underwater noise generated by tidal turbines in shallow water. In,* 30th International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2011), Rotterdam, NL, 19 - 24 Jun 2011. *9pp.

The modelling of underwater noise sources and their potential impact on the marine environment is considered, focusing on tidal turbines in shallow water. The requirement for device noise prediction as part of environmental impact assessment is outlined and the limited amount of measurement data and modelling research identified. Following the identification of potential noise sources, the dominant flowgenerated sources are modelled using empirical techniques. The predicted sound pressure level due to inflow turbulence for a typical turbine is estimated to give third-octave-bandwidth pressure levels of 119 dB re 1 µPa at 20 metres from the turbine at individual frequencies. This preliminary estimate reveals that this noise source alone is not expected to cause permanent or temporary threshold shift in the marine animals studied.

http://eprints.soton.ac.uk/192957/

Andrew J. Wright and Lindy Weilgart. Assessing cumulative impacts of underwater noise with other stressors on marine mammals. J. Acoust. Soc. Am. Volume 129, Issue 4, pp. 2394-2394 (2011).

Cumulative impact assessments (CIAs) are an often unmet requirement in many environmental impact assessment processes. However, marine mammals are typically exposed to multiple human activities and pollutants including noise, which can combine in various ways including through chronic stress responses. To address the issue, the Okeanos Foundation held an international, multi-disciplinary workshop in Monterey, CA (August 2009). Participants considered three aspects: how currently available tools for regionally mapping several anthropogenic pressures on the environment could be applied to species management, how the reported consequences in marine mammals of exposure to these pressures and their known interactions within an individual could be modeled, and how population modeling could include cumulative impacts. Participants felt that all three approaches could be realized in certain data-rich marine mammal populations, which could then be used as examples for informing management decisions in other marine mammals. The population modeling for cumulative impacts on Western gray whales and Southern and North Atlantic right whales is currently underway. Participants believed that marine spatial planning would facilitate better CIAs and that reducing ocean noise is an achievable goal that will help marine life cope with less tractable threats such as climate change.

http://asadl.org/jasa/resource/1/jasman/v129/i4/p2394_s1?bypassSSO=1

E. Lozano-Minguez, A.J. Kolios, F.P. Brennan. Multi-criteria assessment of offshore wind turbine support structures. Renewable Energy, Volume 36, Issue 11, November 2011, Pages 2831–2837.

Wind power, especially offshore, is considered one of the most promising sources of 'clean' energy towards meeting the EU and UK targets for 2020 and 2050. Deployment of wind turbines in constantly increasing water depths has raised the issue of the appropriate selection of the most suitable support structures' options. Based on experience and technology from the offshore oil and gas industry, several different configurations have been proposed for different operational conditions. This paper presents a methodology for the systematic assessment of the selection of the most preferable, among the different configurations, support structures for offshore wind turbines, taking into consideration several attributes through the widely used multi-criteria decision making method TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) for the benchmarking of those candidate options. An application comparing a monopile, a tripod and a jacket, for a reference 5.5 MW wind turbine and a reference depth of 40 m, considering multiple engineering, economical and environmental attributes, will illustrate the effectiveness of the proposed methodology.

http://www.sciencedirect.com/science/article/pii/S019592551100076X

Chris Frid, Eider Andonegi, Jochen Depestele, Adrian Judd, Dominic Rihan, Stuart I. Rogers, Ellen Kenchington. The environmental interactions of tidal and wave energy generation devices. Environmental Impact Assessment ReviewVolume 32, Issue 1, January 2012, Pages 133–139.

Global energy demand continues to grow and tidal and wave energy generation devices can provide a significant source of renewable energy. Technological developments in offshore engineering and the rising cost of traditional energy means that offshore energy resources will be economic in the next few years. While there is now a growing body of data on the ecological impacts of offshore wind farms, the scientific basis on which to make informed decisions about the environmental effects of other offshore energy developments is lacking. Tidal barrages have the potential to cause significant ecological impacts particularly on bird feeding areas when they are constructed at coastal estuaries or bays. Offshore tidal stream energy and wave energy collectors offer the scope for developments at varying scales. They also have the potential to alter habitats. A diversity of designs exist, including floating, mid-water column and seabed mounted devices, with a variety of moving-part configurations resulting in a unique complex of potential environmental effects for each device type, which are discussed to the extent possible.

http://www.sciencedirect.com/science/article/pii/S019592551100076X

Megannety, Michele. A review of the planned shipping activity for the Baffinland Mary River Project: assessing the hazards to marine mammals and migratory birds, and identifying gaps in proposed mitigation measures. Graduate Project, Dalhousie University Halifax, Nova Scotia. 155pp.

Exploration for minerals, oil, and natural gas, as well as their exploitation and transportation, is heavily reliant on marine transportation. Global demand for these natural resources, as well as a rise in Arctic warming and a loss of ice-cover, has led to increased interest in the economic potential of the region. As a result, stronger ice-resistant vessels are being constructed to meet the growing commercial demand, designed to endure the hazards posed by the harsh northern operating conditions. However, the Arctic marine environment remains exceptionally vulnerable to disturbance from shipping activity. This project identifies and assesses potential threats to marine

mammals and migratory birds from the proposed shipping activities of the Baffinland Mary River Project, specifically threats to the Bowhead Whale, Atlantic Walrus, Common Eider, and Thick-billed Murre. Specifically, this project assesses hazards including oil pollution, disturbance from vessel strikes, noise, light, and disturbance to habitat due to icebreaking. While it was determined that the possibility of an oil spill occurring along the shipping route represents the greatest risk to wildlife with respect to consequence, it is less likely that such an incident will occur compared to the other threats considered. Furthermore, while the immediate consequences of these other threats are not as high, the cumulative impacts of these hazards are a major concern. As such, several methods for minimizing the risks to marine mammals and migratory birds are proposed. The intent is to establish a benchmark for minimizing environmental risks from future development in the Canadian Arctic. Therefore, it is critical that legislation, policy, and enforcement be incorporated into risk management strategies, in order to minimize immediate acute disturbances as well as the cumulative impacts caused by shipping activity over the life of a project.

http://dalspace.library.dal.ca/bitstream/handle/10222/14314/Megannety_2011_MMM.pdf?sequence=1

Simpson SD, Radford AN, Tickle EJ, Meekan MG, Jeffs AG (2011) Adaptive Avoidance of Reef Noise. PLoS ONE 6(2): e16625. doi:10.1371/journal.pone.0016625

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0016625

Auditory information is widely used throughout the animal kingdom in both terrestrial and aquatic environments. Some marine species are dependent on reefs for adult survival and reproduction, and are known to use reef noise to guide orientation towards suitable habitat. Many others that forage in food-rich inshore waters would, however, benefit from avoiding the high density of predators resident on reefs, but nothing is known about whether acoustic cues are used in this context. By analysing a sample of nearly 700,000 crustaceans, caught during experimental playbacks in light traps in the Great Barrier Reef lagoon, we demonstrate an auditory capability in a broad suite of previously neglected taxa, and provide the first evidence in any marine organisms that reef noise can act as a deterrent. In contrast to the larvae of species that require reef habitat for future success, which showed an attraction to broadcasted reef noise, taxa with a pelagic or nocturnally emergent lifestyle actively avoided it. Our results suggest that a far greater range of invertebrate taxa than previously thought can respond to acoustic cues, emphasising yet further the potential negative impact of globally increasing levels of underwater anthropogenic noise.

Rob Williams, Shane Gero, Lars Bejder, John Calambokidis, Scott D. Kraus, David Lusseau, Andrew J. Read, Jooke Robbins. (2011) Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. Conservation Letters,

http://onlinelibrary.wiley.com/doi/10.1111/j.1755-63X.2011.00168.x/abstract;jsessionid=62C151E1131B2B8C3927DC25861DC2F3.d03t04

Evaluating impacts of human activities on marine ecosystems is difficult when effects occur out of plain sight. Oil spill severity is often measured by the number of marine birds and mammals killed, but only a small fraction of carcasses are recovered. The Deepwater Horizon/BP oil spill in the Gulf of Mexico was the largest in the U.S. history, but some reports implied modest environmental impacts, in part because of a relatively low number (101) of observed marine mammal mortalities. We estimate historical carcass-detection rates for 14 cetacean species in the northern Gulf of Mexico that have estimates of abundance, survival rates, and stranding records. This preliminary analysis suggests that carcasses are recovered, on an average, from only 2% (range: 0–6.2%) of cetacean deaths. Thus, the true death toll could be 50 times the number of carcasses recovered, given no additional information. We discuss caveats to this estimate, but present it as a counterpoint to illustrate the magnitude of misrepresentation implicit in presenting observed carcass counts without similar qualification. We urge methodological development to develop appropriate multipliers. Analytical methods are required to account explicitly for low probability of carcass recovery from cryptic mortality events (e.g., oil spills, ship strikes, bycatch in unmonitored fisheries and acoustic trauma).

Michel André (1), Mike van der Schaar (1), Serge Zaugg (1), Ludwig Houégnigan (1), Antonio M. Sánchez (1), Alex Mas (1) (2011) FROM OFFLINE RECORDINGS TO REAL-TIME ANALYSIS OF OCEAN NOISE AND ACOUSTICS EVENTS AT UNDERWATER OBSERVATORIES. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

Passive acoustic monitoring has the potential to be implemented continuously and over long time periods, resulting in large and representative datasets. However, this inevitably leads to a high rate of audio data acquisition that could be problematic when the data needs to be transmitted, stored or analyzed. For observatories with a limited power supply, transmission, storage or additional data processing (*e.g.* automated classification, data compression) have to be optimized, which may imply the loss of potentially interesting information. For cabled observatories where power and communication are not an issue, limitations arise with storage. In any case, the need for immediate mitigation actions when facing acoustic events that could result harmful to individuals or populations, and the necessity of long-term monitoring of noise, calls for the development of a robust technique able to provide both historical statistical data on noise and alarms on specific acoustic events: *i.e.* a fully automated real-time detection and classification system that would be able to

provide this information while minimizing technical costs. The approach proposed here divides the recording bandwidth in frequency bands that cover the acoustic niche of most species and secondly applies to these bands a series of detectors and classifiers (as well as localization and tracking algorithms), that also allow to assess the short-, medium- and long-term contribution of noise sources in these acoustic niches. The Laboratory of Applied Bioacoustics (LAB) of the Technical University of Catalonia has developed and implemented at several underwater observatories in Europe (ESONET, European Sea-Floor Observatories Network of Excellence) and Canada (NEPTUNE, NorthEast Pacific Time-Series Undersea Networked Experiments) an automated real-time DCL system that has proven to be reliable and efficient. The live audio data stream as well as the output of the statistical analysis can be accessed online at http://listentothedeep.com

Lucia Martina Martin (2, 3), Ricardo Sagarminaga (1), Ana Tejedor (1), Albert López-Larrosa (4), Natacha Aguilar (2, 5) (2011) AREA MARINE PROTECTED (AMP) AREAS FREE OF ACOUSTIC POLLUTION? CASE EXAMPLES OF NOISE FROM FISHING AND SHIPPING ACTIVITIES IN DEEPWATER AREAS OF THE MEDITERRANEAN. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

Cetaceans and other marine fauna use sound for vital functions such as communication, foraging and predator detection. Signals mediating these functions can be masked by increased levels of ambient noise. Therefore, buffering from acoustic pollution should be considered when designing MPA. Some sources of noise can increase background noise levels at large distances. This is most relevant for “chronic” activities occurring repeatedly in an area. Here we analyze two chronic sources of anthropogenic noise in some areas of the Mediterranean: bottom-trawling fishing and shipping lines. The study was performed within the context of the EU project LIFE+INDEMARES and we present
case examples showing that noise produced outside MPA has the potential to affect marine life within the borders of MPA. Recordings were taken in two key areas for the Natura2000Network: Cap de Creus (Catalunya) and Alboran Sea. Point sound samples (30min) were gathered with a calibrated hydrophone (Reson TC4032). In Cap de Creus, broadband (100Hz-40kHz) noise levels increased by 15dB re 1µPaRMS in recordings performed at 0.5, 1.2 and 1.4km from trawling boats over recordings in the same area with no boats in a 6nm radius. Under the conservative assumptions of the closest boat dominating the noise signature and spherical sound transmission, the radius at which trawling noise exceeds usual background noise in this area is around 3km. The Alboran Sea is crossed by over 25% of the World’s shipping activity, with the main shipping line located north of the Alboran Island. We performed recordings following a north-south transect and low frequency noise (<150Hz) broadband sound levels in the most northern point (18km from Alboran Is.) exceeded in 10dB re 1µPaRMS the levels in the other recordings. This examples point to the need of gathering long-term datasets of acoustic levels in MPA and create “acoustic buffer zones” around them.

Ursula Verfuss (1), Sven Adler (1), Anja Brandecker (1), Michael Dähne (2), Ansgar Diederichs (3), Anja Gallus (1), Anne Herrmann (1), Kathrin Krügel (1), Klaus Lucke (2011) AMPOD: APPLICATIONS AND ANALYSIS METHODS FOR THE DEPLOYMENT OF T-PODS IN ENVIRONMENTAL IMPACT STUDIES FOR WIND FARMS: COMPARABILITY AND DEVELOPMENT OF STANDARD METHODS. ABSTRACT BOOK 25th CONFERENCE OF THE EUROPEAN CETACEAN SOCIETY 21st – 23rd MARCH 2011, CÁDIZ/SPAIN

http://www.circe.biz/files/Abstract_book_ECS2011-11.pdf

In the expansion of regenerative energy, offshore-wind farms take up a special relevance. Construction and operation of wind farms, however, influence the marine environment. In German waters, the German Federal Maritime and Hydrographic Agency commit wind farm project applicants to conduct environmental impact studies (EIS) by regulations outlined in the “Standards for the Environmental Impact Assessment” (StUK3). Amongst others, StUK3 is describing how to investigate the habitat use of harbour porpoises with acoustic data loggers (porpoise detectors, PODs). These register echolocation clicks used for orientation, foraging and communication. The AMPOD-project aimed for developing standard methods and guidelines for the application of PODs in static acoustic monitoring (SAM) programs in EIS for wind farms. We investigated the influences of different parameters on data retrieval with T-PODs (Timing porpoise detectors), and compared different analysis methods. This knowledge helps for a better interpretability and comparability of results obtained - not only with TPODs - in SAM studies. The results show the importance of calibrating SAM-devices. Adjusting the devices to a standard sensitivity helps to gather comparable data. Other issues: T-PODs with different deployment depths retrieved significantly different data in water depths greater than 20m, most likely caused by the porpoises’ preference of certain water depths or by thermoclines interfering with the T-POD detection abilities. Above a certain level of background noise received by the monitoring devices, noise affects data by masking true detections or raising the number of false positives. Analysis of data should therefore consider recorded background noise, either by excluding or adjusting data retrieved at certain noise levels. We tested a model that may be applicable under certain conditions to align data recorded with devices of different sensitivity. We will introduce recommendations and guidelines on how to conduct SAM with PODs and propose standard procedures for POD application and data analysis.

MARINE TOP PREDATORS AND RENEWABLES; SURVEY AND RESEARCH REQUIREMENTS Workshop Report 18-19th

http://www.masts.ac.uk/documents/MASTSPredReneWshop.pdf

There is a growing and urgent need to better understand the potential impacts of offshore wind, tidal and wave devices on seabirds and marine mammals, and for advice on the most appropriate techniques for baseline surveys and impact studies. This two day workshop, organised through the MASTS Marine Predators Joint Research Theme (www.masts.ac.uk), brought together researchers, regulators and industry to identify survey and research requirements, and opportunities for knowledge transfer

2010

Cranford TW, Krysl P, Amundin M (2010) A New Acoustic Portal into the Odontocete Ear and Vibrational Analysis of the Tympanoperiotic Complex. PLoS ONE 5(8): e11927. doi:10.1371/journal.pone.0011927

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0011927

Global concern over the possible deleterious effects of noise on marine organisms was catalyzed when toothed whales stranded and died in the presence of high intensity sound. The lack of knowledge about mechanisms of hearing in toothed whales prompted our group to study the anatomy and build a finite element model to simulate sound reception in odontocetes. The primary auditory pathway in toothed whales is an evolutionary novelty, compensating for the impedance mismatch experienced by whale ancestors as they moved from hearing in air to hearing in water. The mechanism by which high-frequency vibrations pass from the low density fats of the lower jaw into the dense bones of the auditory apparatus is a key to understanding odontocete hearing. Here we identify a new acoustic portal into the ear complex, the tympanoperiotic complex (TPC) and a plausible mechanism by which sound is transduced into the bony components. We reveal the intact anatomic geometry using CT scanning, and test functional preconceptions using finite element modeling and vibrational analysis. We show that the mandibular fat bodies bifurcate posteriorly, attaching to the TPC in two distinct locations. The smaller branch is an inconspicuous, previously undescribed channel, a cone-shaped fat body that fits into a thin-walled bony funnel just anterior to the sigmoid process of the TPC. The TPC also contains regions of thin translucent bone that define zones of differential flexibility, enabling the TPC to bend in response to sound pressure, thus providing a mechanism for vibrations to pass through the ossicular chain. The techniques used to discover the new acoustic portal in toothed whales, provide a means to decipher auditory filtering, beam formation, impedance matching, and transduction. These tools can also be used to address concerns about the potential deleterious effects of high-intensity sound in a broad spectrum of marine organisms, from whales to fish.

Kot CY, Fujioka E, Hazen LJ, Best BD, Read AJ, et al. (2010) Spatio-Temporal Gap Analysis of OBIS-SEAMAP Project Data: Assessment and Way Forward. PLoS ONE 5(9): e12990. doi:10.1371/journal.pone.0012990

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0012990

The OBIS-SEAMAP project has acquired and served high-quality marine mammal, seabird, and sea turtle data to the public since its inception in 2002. As data accumulated, spatial and temporal biases resulted and a comprehensive gap analysis was needed in order to assess coverage to direct data acquisition for the OBIS-SEAMAP project and for taxa researchers should true gaps in knowledge exist. All datasets published on OBIS-SEAMAP up to February 2009 were summarized spatially and temporally. Seabirds comprised the greatest number of records, compared to the other two taxa, and most records were from shipboard surveys, compared to the other three platforms. Many of the point observations and polyline tracklines were located in northern and central Atlantic and the northeastern and central-eastern Pacific. The Southern Hemisphere generally had the lowest representation of data, with the least number of records in the southern Atlantic and western Pacific regions. Temporally, records of observations for all taxa were the lowest in fall although the number of animals sighted was lowest in the winter. Oceanographic coverage of observations varied by platform for each taxa, which showed that using two or more platforms represented habitat ranges better than using only one alone. Accessible and published datasets not already incorporated do exist within spatial and temporal gaps identified. Other related open-source data portals also contain data that fill gaps, emphasizing the importance of dedicated data exchange. Temporal and spatial gaps were mostly a result of data acquisition effort, development of regional partnerships and collaborations, and ease of field data collection. Future directions should include fostering partnerships with researchers in the Southern Hemisphere while targeting datasets containing species with limited representation. These results can facilitate prioritizing datasets needed to be represented and for planning research for true gaps in space and time.

Yovel Y, Au WWL (2010) How Can Dolphins Recognize Fish According to Their Echoes? A Statistical Analysis of Fish Echoes. PLoS ONE 5(11): e14054. doi:10.1371/journal.pone.0014054

http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0014054

Echo-based object classification is a fundamental task of animals that use a biosonar system. Dolphins and porpoises should be able to rely on echoes to discriminate a predator from a prey or to select a desired prey from an undesired object. Many studies have shown that dolphins and porpoises can discriminate between objects according to their echoes. All of these studies however, used unnatural objects that can be easily characterized in human terminologies (e.g., metallic spheres, disks, cylinders). In this work, we collected real fish echoes from many angles of acquisition using a sonar system that mimics the emission properties of dolphins and porpoises. We then tested two alternative statistical approaches in classifying these echoes. Our results suggest that fish species can be classified according to echoes returning from porpoise- and dolphin-like signals. These results suggest how dolphins and porpoises can classify fish based on their echoes and provide some insight as to which features might enable the classification.

Hans Slabbekoorn, , Niels Bouton, Ilse van Opzeeland, Aukje Coers, Carel ten Cate1 and Arthur N. Popper (2010) A noisy spring: the impact of globally rising underwater sound levels on fish Trends in Ecology & Evolution Volume 25, Issue 7, July 2010, Pages 419-427

http://epic.awi.de/Publications/Sla2010a.pdf

The underwater environment is filled with biotic and abiotic sounds, many of which can be important for the survival and reproduction of fish. Over the last century, human activities in and near the water have increasingly added artificial sounds to this environment. Very loud sounds of relatively short exposure, such as those produced during pile driving, can harm nearby fish. However, more moderate underwater noises of longer duration, such as those produced by vessels, could potentially impact much larger areas, and involve much larger numbers of fish. Here we call attention to the urgent need to study the role of sound in the lives of fish and to develop a better understanding of the ecological impact of anthropogenic noise.

Barber, Crooks, Fristrup. (2010) The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution Volume 25, Issue 3

www.sciencedirect.com

Growth in transportation networks, resource extraction, motorized recreation and urban development is responsible for chronic noise exposure in most terrestrial areas, including remote wilderness sites. Increased noise levels reduce the distance and area over which acoustic signals can be perceived by animals. Here, we review a broad range of findings that indicate the potential severity of this threat to diverse taxa, and recent studies that document substantial changes in foraging and anti-predator behavior, reproductive success, density and community structure in response to noise. Effective management of protected areas must include noise assessment, and research is needed to further quantify the ecological consequences of chronic noise exposure in terrestrial environments.

Wade, Whitehead, Weilgart. (2010) Conflict of interest in research on anthropogenic noise and marine mammals: Does funding bias conclusions? Marine Policy 34 320-327.

www.sciencedirect.com

The U.S. Navy, whose sonars kill marine mammals, provides approximately 50% of the funds for marine mammal research worldwide. We examined six reviews of research on the effects of anthropogenic sound on marine mammals, as well as the primary papers cited in the reviews. These reviews cite references showing noise has no effect on marine mammals at an increasing frequency as their funding moves from a conservation organization to independent to partial U.S. military sources. Primary papers are 2.3 times more likely to be cited in the reviews as concluding no effect of noise if the research was militarily-funded than if not. Thus, conflict of interest may have led to a misrepresentation of the effects of noise on marine mammals in both the primary and secondary literature, and thus misinform public policy decisions.

Hemilae S, Nummela* S, Reuter T (2010) Anatomy and physics of the exceptional sensitivity of dolphin hearing (Odontoceti: Cetacea). Journal of Comparative Physiology, A 196:165-179

http://www.springerlink.com/content/b2652797833p3538

During the past 50years, the high acoustic sensitivity and the echolocation behavior of dolphins and other small odontocetes have been studied thoroughly. However, understanding has been scarce as to how the dolphin cochlea is stimulated by high frequency echoes, and likewise regarding the ear mechanics affecting dolphin audiograms. The characteristic impedance of mammalian soft tissues is similar to that of water, and thus no radical refractions of sound, nor reflections of sound, can be expected at the water/soft tissue interfaces. Consequently, a sound-collecting terrestrial pinna and an outer ear canal serve little purpose in underwater hearing. Additionally, compared to terrestrial mammals whose middle ear performs an impedance match from air to the cochlea, the impedance match performed by the odontocete middle ear needs to be reversed to perform an opposite match from water to the cochlea. In this paper, we discuss anatomical adaptations of dolphins: a lower jaw collecting sound, thus replacing the terrestrial outer ear pinna, and a thin and large tympanic bone plate replacing the tympanic membrane of terrestrial mammals. The paper describes the lower jaw anatomy and hypothetical middle ear mechanisms explaining both the high sensitivity and the converted acoustic impedance match.

III The potential for joint initiatives on noise and disturbance with ACCOBAMS and/or OSPAR:

ACCOBAMS

The chairs of the of ACCOBAMS and ASCOBANS noise working groups agreed on a joint approach to draft specific stakeholder guidelines (seismic, military, shipping and offshore construction) based on the original ACCOBAMS and ACCOBAMS guidelines and new knowledge (for instant The assessment of the implementation by ASCOBANS Parties of the different aspects of the Resolution No. 2 on adverse effects of underwater noise on marine mammals during offshore construction activities for renewable energy production, as adopted at the 6th Meeting of the Parties of ASCOBANS). A draft of offshore construction/renewables is already in consideration by both groups.

Based on the assessment (see above) and consultation with stakeholders the chair of the ACCOBAMS group Yanis Souami drafted a new questionnaire. The purpose is to ensure that these advice documents are useful and applicable for the stakeholders. Following these stakeholder consultations, the suggested Joint Working Group will finalize the advice documents and present them to Parties.

In a teleconference of the chairs of the two noise working groups, representatives of the Secretariats and advisors, it was agreed to propose a formal merging of the two working groups. To this effect, the “Draft Letter to the ASCOBANS and ACCOBAMS Noise Working Groups” (4.14) is presented to the ASCOBANS Advisory Committee for comments.

OSPAR

Needs to be developed

IV Potential terms of reference for a report (or reports) that might

Examine ways in which ASCOBANS can assist Parties in meeting the requirements of the relevant European Directives (i.e. the Marine Strategy Framework Directive and the Habitats Directive) and other bodies that countries have elected to adhere to which are concerned with marine noise;

This section depends strongly on the work of the EU technical subgroup noise. This work is still in progress and therefore this section needs to be filled later this year.

However, the SC7 of ACCOBAMS (Monaco, 29-31 March 2011) suggested to create a common ASCOBANS / ACCOBAMS working group on the EU Marine Strategy Framework Directive to work on general aspects of the directive (not limited to noise). This working group will go deeper on this issue to collect more material for the next ACCOBAMS Scientific Committee. The Representative of ASCOBANS Heidrun Frisch welcomed the idea to have a common working group, and informed the Meeting that she would suggest the idea to the next ASCOBANS Advisory Meeting.

The 18th ASCOBANS Advisory Committee Meeting (Bonn, Germany, 4-6 May 2011) welcomed the proposal and suggested terms of reference for this joint working group. In consultation with Parties of both Agreements, these terms of reference are currently being finalized and a first call for nominations to the working group has been made. The group is expected to become fully functional shortly following the 19th ASCOBANS Advisory Committee Meeting.

Provide Parties with information about mitigating technologies and management measures, and their effectiveness and cost.

Please see Draft OSPAR Guidance on Measures to Mitigate the Emission and Environmental Impact of Underwater Noise (2012).

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