Institution: University of Aberdeen

Unit of Assessment: 5 - Biological Sciences

Title of case study: Aberdeen research underpins guidelines for assessing and lessening impacts of offshore energy developments on protected marine mammal populations

1. Summary of the impact

Achievement of energy security and the UK's 2020 carbon targets economy depends upon a mix of new offshore oil and gas and renewable energy developments, but concern that seismic survey and construction noise could pose an unacceptable risk to marine mammals threatens to delay these plans.

University of Aberdeen ecologists, under the direction of Paul Thompson, have developed long-term studies of marine mammal population dynamics that now underpin frameworks for assessing and mitigating the impacts of such developments on marine mammals in EU protected areas.

The specific impact on commerce and the environment is that this assessment process has been adopted by industry within their consent applications. As a result of academic consultancy in industry, planning decisions have been informed by the research, and the management of environmental risks has changed. This has reduced the consenting risk for industry and provided an assessment framework that allows regulators to ensure that they are implementing current government policy within international legal frameworks for environmental protection.

2. Underpinning research

As a result of the University of Aberdeen's long-term ecological studies of coastal harbour seal and bottlenose dolphin populations in Scotland's Moray Firth, these species are now two of the most intensively studied marine mammal populations in the world. Professor Paul Thompson of the University of Aberdeen initiated and has led this integrated research programme for over two decades, using tracking [1] and observational [2] techniques to identify key foraging habitats, and sustained population level studies to understand how distribution and abundance vary through time [1, 3 and 4]. Studies of harbour seals were initially developed through a series of Scottish Office contracts that supported Thompson as a research fellow, and have been maintained between 1993 and 2011 through 6 PhD studentships at Aberdeen, including collaboration with Hammond (St Andrews) and Armstrong (Marine Scotland Science). Studies of bottlenose dolphins were developed in collaboration with Hammond (St Andrews) and have been maintained through 4 Aberdeen-based PhD studentships and 6 externally-funded Research Fellows.

In 2004, Thompson used this understanding of population ecology to develop studies that addressed uncertainty over the potential impacts of offshore energy developments on new marine protected areas (EU Special Areas of Conservation), established in response to the EU Habitats Directive. Research carried out with two EU funded Research Fellows (Bailey & Lusseau) during the installation of the world's first offshore deep-water wind turbines tested acoustic propagation models, and confirmed the potential for far-field disturbance of marine mammals [5]. At the same time, this research demonstrated weaknesses in traditional assessments of impacts using impact and control areas, and the need for analyses along gradients of impact [6]. Recommendations resulting from this work underpinned the development of a large-scale assessment of behavioural responses of small cetaceans to industrial noise, involving a gradient design across a study area of over 2000 km^2, and an assessment of the spatial scale at which these animals responded to a full-scale commercial seismic survey. This programme was funded by the UK's Department of Energy & Climate Change (DECC) and has been developed and co-ordinated by Thompson, working with Aberdeen-based Research Fellows [Brookes (2009-2012), Graham (2011–Present) & Cordes (2011-2012)] and commercial sub-contractors at Kongsberg Maritime & WWT Consulting Ltd. The survey approaches developed and validated for this study provided the additional data required by the UK Government to licence the seismic survey, and represented the first field test of alternative survey approaches available to underpin consenting of deepwater offshore wind farms licensed through the Scottish Territorial Waters and Round 3 licensing rounds. In 2011, this field test was further developed to compare novel digital survey technologies in collaboration with Borchers and

Hammond (St Andrews) through a contract from Marine Scotland. Between 2010 and 2012, industry (Energias de Portugal Renewables, Scottish & Southern Energy Renewables & Repsol) also invested in additional research on the offshore distribution of marine mammals to support consent applications for their major joint venture windfarms (Moray Offshore Renewables Ltd and Beatrice Offshore Wind Ltd). Thompson also worked with their environmental teams [Maclean (Natural Power), Hastie (SMRU Ltd) & Nedwell (Subacoustech)], extending modelling work previously used to assess impacts of fisheries [4] and led the development of new frameworks for assessing the population consequences of noise from wind farm construction, allowing comparison of alternative construction options and demonstrating to regulators that proposals will meet international agreements on environmental protection. Since 2012, with funding from the NERC MREKE programme and industry, Thompson and Lusseau at Aberdeen have subsequently worked with collaborators at the University of St Andrews to develop these frameworks for other populations which lack the detailed baseline data available from the Moray Firth research programme.

3. References to the research

[1] Cordes, LS, Duck, CD, Mackey, BL, Hall, AJ, & Thompson, PM. (2011). Long-term patterns in harbour seal site-use and the consequences for managing protected areas. *Animal Conservation* 14, 430-438. *Paper based on a 20-year time-series of data that demonstrates a shift in distribution at terrestrial breeding sites but consistent use of foraging areas by tagged female harbour seals.*

[2] Bailey, H & Thompson, PM. (2009). Using marine mammal habitat modelling to identify priority conservation zones within a marine protected area. *Marine Ecology Progress Series*, 378, 279-287. *Paper that uses survey-based data in habitat association models to identify key areas for bottlenose dolphins within the largest marine Special Area of Conservation in UK waters.*

[3] Wilson, B, Hammond, PS & Thompson, PM. (1999). Estimating size and assessing status of a coastal bottlenose dolphin population. *Ecological Applications*, 9, 288-300. *Paper that used mark-recapture analysis of individually identified bottlenose dolphin in the Moray Firth to provide the first estimate of population size for any cetacean in European waters, and assessed the power of different monitoring schemes to detect future population change.*

[4] Thompson, PM, Mackey, BL, Barton, TR, Duck, C & Butler, JRA (2007). Assessing the potential impact of salmon fisheries management on the conservation status of harbour seals in NE Scotland. *Animal Conservation,* 10, 48-56. *Paper that identified a significant decline in abundance within an EU Special Area of Conservation for harbour seals. Collaboration with key fisheries organisations identified high levels of previously unreported shooting, which population modelling indicated was sufficient to drive observed declines.*

[5] Bailey, H, Parvin, S, Senior, B, Simmons, D, Rusin, J, Picken, G & Thompson, PM. (2010). Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine Pollution Bulletin,* 60, 888-897. *Paper that reports the first far field recordings of pile driving noise during construction at the world's first deep water wind turbine, highlighting that pile driving noise could be detected at distances of up to 70 km, potentially disturbing small cetaceans at distances of 20 km from source.*

[6] 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. *Paper that demonstrates how passive acoustic monitoring can be used to assess responses of cetaceans to wind farm construction, highlights the constraints of traditional approaches to impact assessment and recommends alternative monitoring programmes.*

The publications underpinning these impacts were all in international peer-reviewed journals. Although several have only been published within the last 2 years, they have collectively attracted 147 citations.

Key grant funding associated with the research:

[i] *Moray Offshore Renewables Ltd & Beatrice Offshore Wind Ltd* (2010-2012) Assessing the impact of windfarm construction on Moray Firth marine mammals. £325,000

[ii] *DECC* (2009-2013) Assessing the impact of seismic surveys on cetaceans. £1,957,600

[iii] *Scottish Government & Scottish Natural Heritage* (2006-2009) Abundance and population structure of Scottish Bottlenose Dolphins £464,944

[iv] *EU 6th Fr & Talisman Energy (UK) Ltd* (2005-2007) Assessing the impact of demonstration offshore wind turbines on seabirds and cetaceans. £166,974

[v] *Scottish Natural Heritage* (2004-2012) Bottlenose dolphin site condition monitoring in the Moray Firth SAC £135,370

[vi] *NERC* (1993-1995) Molecular-based studies of individual differences in the diet seals. £115,945 Thompson, Co-PI with Amos (Cambridge).

[vii] *Scottish Office* (1993-1997) Population and foraging ecology of Moray Firth seals. £252,665

Studies of the effects of marine renewable have developed through a continuous series of grants and contracts that have been obtained through open competition involving peer-review. More recently, these have sometimes attracted invited single tender contracts from government and industry [grants ii-iii], which has required detailed scrutiny and, for government bodies, ministerial approval. Such projects were subsequently overseen by a broad steering group of external academics and stakeholders.

4. Details of the impact

The research programme has been designed to maximise impact on public policy, commerce and society through direct interaction of researchers and management organisations, industry support for research and academic consultancy, and the integration of research output into education, media and public arts programmes.

Influencing environmental policy decisions and the management of natural resources The presence of Aberdeen's comprehensive research programme in important marine mammal habitats led to Thompson joining groups that developed frameworks to manage EU Special Areas of Conservation [SNH Regional and Science Board Member (1993-1997) and Scientific Advisor for the Moray Firth SAC Management Group (2000-2009)]. Work with this broad range of stakeholders facilitated dissemination of relevant research on population drivers and underpinned subsequent policy changes in the way that Scottish Government manages these natural populations when regulating offshore energy developments. Working through a broader group led by the Scottish Government, Aberdeen research demonstrated that population declines were linked to high levels of shooting [4]. This led to a paradigm shift in the way Scottish seal populations are managed through the 2005 Moray Firth Seal Management Plan and the new 2010 Marine (Scotland) Act [b].

Industry support for research The impact of Aberdeen's research on offshore energy developments arose through Talisman Energy (UK) Ltd. jointly funding a PhD. Talisman subsequently contracted Aberdeen to conduct offshore cetacean surveys that were completed in 2001, supporting work on their Beatrice Oilfield. This led to an invitation to join a multi-disciplinary consortium, partly funded by the EU Framework 6 programme, to assess the impacts of deepwater wind farms during construction of the Beatrice Demonstrator Turbines. A key output of this work [6] recommended new approaches for assessing cetacean responses to industrial noise. At this time, public and scientific concern over potential impacts on EU protected populations of bottlenose dolphins had resulted in DECC freezing plans to further develop oil and gas production in the region. As a result, Thompson was invited by DECC to design a £1.9 million research project that, in 2010, provided them with sufficient understanding of cetacean populations in the affected areas to allow further seismic surveys [a] and, in 2011, studied cetacean responses to those surveys.

Academic consultancy This research has directly impacted the consenting process adopted by the two offshore wind farm companies developing projects within the Moray Firth - Moray Offshore Renewables Ltd and Beatrice Offshore Wind Ltd, international leaders in this sector. No procedures previously existed for assessing construction impacts on EU protected populations of marine mammals, resulting in a serious consenting risk for these and other UK offshore wind farms. Thompson worked with these environmental and engineering teams [c], liaising closely with regulatory bodies, and led the development of a framework for assessing impacts on protected seal populations [d]. This has been used in consent applications during 2012, demonstrating how planning decisions have been informed by this research [a]. Other developments are now generalising these processes for use in areas which lack the local data available to the Moray Firth

developers through Aberdeen's research programme.

Public understanding of environmental and policy issues In parallel to these developments, recent outreach has focused on activities that improve stakeholder and public understanding of underwater noise issues, and inform debate on balancing the demands of EU legislation on nature conservation and carbon emissions [e]. An arts-science collaboration funded by Creative Scotland and Highlands & Islands Enterprise attracted national media coverage for works by sound and visual artists, and Aberdeen researchers co-organised workshops for schools and for the regulators and statutory advisors who are dealing with offshore renewable planning applications.

Claimed Impact as defined by REF: Decisions by regulatory authorities have been influenced by research, industry has invested in research and development*, new assessment processes have been adopted, and public understanding has improved.*

5. Sources to corroborate the impact

[a] **Influencing regulatory decisions***.* The DECC Appropriate Assessment for further oil exploration in the Moray Firth (https://163.164.19.97/environment/aa_2212.pdf) includes extensive reference to Aberdeen research that underpinned this consent decision (See Sections 8.3-8.7, Figs 8-12 and Section 9.7, fig 16). A testimonial from Marine Scotland explains that "*Aberdeen University's research has changed the way which developers are assessing the long-term impacts of offshore wind farm developments...clearly indicating that developments can be consented without affecting the long-term status of protected marine mammals*"

[b] Changes in the way that seal populations are managed in the Moray Firth are described in Butler et al. (2008) *Aquatic Conservation: Marine and Freshwater Ecosystems*, 18: 1025-1038, and subsequent changes in national seal management are outlined at: www.scotland.gov.uk/Topics/marine/marine-environment/species/19887/20814

[c] **Industry investment in R & D***.* Environmental Statements supporting consent applications for the first offshore wind farm applications under the Scottish Territorial Waters (Beatrice Offshore Wind Ltd and UK Round 3 (Moray Offshore Renewables Ltd) each contains sections outlining how Aberdeen research underpinned their environmental assessment. For example see pp 20-29 of MORL Marine Mammal EIA Appendix (http://morayoffshorerenewables.com/getmedia/37a382dd-f907-420f-902b-8e399fc7ca97/Appendix-7-3-A---Marine-Mammals-Impact-Assessment.pdf), Chapters 3, 5 & 6 of MORL Marine Mammal Baseline Technical Document (http://morayoffshorerenewables.com/getmedia/82eaad15-7f65-4505-802a-bd9023fb3a7d/Appendix-4-4-A---Marine-Mammals-Baseline.pdf). A testimonial from the CEO of MORL highlights that "*MORL is highly cognisant of the benefits of The University of Aberdeen's marine mammals research programme which has not only made an invaluable contribution to the assessment of the MORL projects in terms of the baseline information available, but which also has enabled the development of the Moray Firth Seal Assessment Framework through the close collaboration of academia and industry.*"

[d] **Adoption of new procedures.** These Environmental Statements also describe the Aberdeen-led development of new procedures to assess population level impacts on EU Protected marine mammals. A description of this process has been published in Thompson et al. (2013) *Environmental Impact Assessment Review* (http://dx.doi.org/10.1016/j.eiar.2013.06.005). As outlined in a testimonial from the Director of Natural Power, Thompson's "*academic consultancy with Natural Power produced an agreed assessment methodology that enabled both Moray Offshore Renewables Ltd and Beatrice Offshore Wind Ltd to submit robust impact assessments to inform Marine Scotland's consenting and HRA processes*".

[e] **Impacts on society, culture & creativity.** Since 2007, two UK networked TV programmes and two BBC Radio 4 programmes have used Aberdeen research to improve public understanding of science and environmental issues (see www.abdn.ac.uk/lighthouse/about/). The wider cultural impact of the Aberdeen arts-science collaboration is highlighted in a BBC Radio 4 "Saving Species" feature (www.bbc.co.uk/programmes/b01mqp1p), a collaboration that has been described as "*one of those inspired mix-and-match exercises that place artists alongside scientists with illuminating results*." (HeraldScotland, 10/11/12). An SNH testimonial confirms that Aberdeen researchers' "*willingness and ability to engage at different levels to convey and promote the key findings from this research has led to improved understanding of environmental and policy issues*"