Agenda Item 5.5	Implementation of the ASCOBANS Triennial Work Plan (2007-2009) Review of New Information on Pollution, Underwater Sound and Disturbance
Document 42 rev.1	**Marine Renewable Energy Development and Scotland's Cetaceans**
Action Requested	• Take note of the information submitted • Comment
Submitted by	WDCS

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MARINE RENEWABLE ENERGY DEVELOPMENT AND SCOTLAND'S CETACEANS

Sarah Dolman
Whale and Dolphin Conservation Society, c/o WDCS Moray Firth Wildlife Centre, Spey Bay, Moray, Scotland, IV32 7PJ; School of Biological Sciences, Zoology Building, Tillydrone Avenue, University of Aberdeen, Aberdeen AB24 2TZ, Scotland

BACKGROUND

The Scottish Government's target of meeting 50% of Scotland's whole electricity demand from renewable energy by 2020 (Scottish Government, 2008) is a bold one, and one which WDCS supports as part of a strategic approach to emissions reductions. We recognise the potential importance of marine renewable energy as a vital part of future energy supply, and that it could make a valuable contribution to reducing greenhouse gas emissions responsible for climate change, providing it is developed in a sustainable and environmentally responsible way. ASCOBANS has already contributed to this discussion, co-sponsoring the European Cetacean Society Workshop entitled 'Offshore wind farms and marine mammals: impacts and methodologies for assessing impacts' (Evans, 2008).

RECENT POLITICAL DEVELOPMENTS

Marine renewable energy powers within 200 nm lie with Westminster, but the Scottish government administers the activities, although with no powers to change the legislation. Scotland has planning powers out to 12 nm currently. The Crown Estate launched Round 3 for marine wind power in the UK in June 2008 (including waters beyond Scotland's territorial waters between 12 and 200 nm). Round 1 and 2 sites were restricted to England and Wales. The UK Strategic Environmental Assessment (SEA) on marine wind, oil and gas licensing and carbon sequestration was provided for public comment in January 2009. The marine wind component of the SEA is aiming towards generating a total of 33 GW (gigawatts) of offshore wind energy (between 5,000 and 7,000 offshore wind turbines). In February 2009, the Crown Estate announced that it will be offering exclusivity agreements to companies and consortia for ten sites for development of offshore wind farms within Scottish territorial waters. These sites are spread out off the east and west coasts, and will contribute to delivering a further 25 GW from offshore wind to that which already exists (Crown Estate, 2009). In addition, the Scottish government has recently announced that it is proposing to conduct an SEA for marine wind energy during 2009. The Scottish Government SEA for marine wind should influence Crown Estate Round 3 decisions about where to site potential developments. It is not currently clear how the UK and Scottish SEA processes for offshore wind farms will be linked, although a strategic approach to the planning of the development of marine renewable energy industries is clearly important. A prominent example is the outer Moray Firth, where wind farms are being proposed both within Scottish territorial waters up to 12 nm and beyond 12 nm under the UK SEA.

In 2005, the Scottish Government commissioned a SEA to examine the potential environmental effects from the development of wave and tidal power devices off the west and north coast of Scotland from Shetland to the Solway Firth to a distance of 12 nautical miles offshore. The SEA was available for public consultation in 2007 and subsequently an

Environmental Report was produced. The SEA determined that between 1,000 MW (megawatts) and 2,600 MW of marine renewable energy generating capacity could be achieved using wave and tidal power devices in the study area. The UK has not conducted an SEA to examine the potential environmental effects from the development of wave and tidal power devices in English and Welsh coastal waters or in offshore UK waters between 12 and 200 nm. This will be an important step forward in strategic environmental planning for marine renewable energy. Strategic considerations for placement of all marine renewable energy developments, including wind, wave and tidal, across the national boundaries should also be considered.

LEGAL PROTECTION

Scotland's 24 species of cetaceans are provided strict protection under the EU Habitats Directive. The EU Habitats Directive lists harbour porpoises, bottlenose dolphins, grey and common seals in Annex II, requiring that Special Areas of Conservation (SAC) be established for their protection. Scotland only has one SAC for bottlenose dolphin protection, in the inner Moray Firth. None currently exist for harbour porpoise protection. There are 23 SACs for grey and common seals in Scottish waters.

National legislation includes the Conservation (Natural Habitats, & c.) Regulations 2004 (as amended) in Scotland to 12 nm. These Regulations offer protection of the individual marine mammal, rather than at a population level and deliberate disturbance and reckless disturbance of a cetacean is an offence. It is also an offence to deliberately or recklessly disturb or harass any cetacean, to disturb any cetacean whilst it is rearing or otherwise caring for its young; to disturb any cetacean in a manner that is, or in circumstances which are, likely to significantly affect its local distribution or local abundance; to disturb any cetacean in a manner that is, or in circumstances which are likely to impair its ability to survive, breed or reproduce, or rear or otherwise care for its young.

It seems likely that lawful (i.e. consented) activities which incidentally give rise to disturbance could constitute deliberate or reckless disturbance, particularly where relevant mitigation measures are untested or known to be of limited effectiveness, as discussed below.

RECENT DEVELOPMENTS IN UNDERSTANDING POTENTIAL IMPACTS

The data reviewed here are those which have been produced since the review provided by Simmonds and Dolman (2008). This review was provided as part of an ASCOBANS/ European Cetacean Society (ECS) Workshop entitled 'Offshore wind farms and marine mammals: impacts and methodologies for assessing impacts' (Evans, 2008), held at the ECS Conference in 2007.

The construction of marine wind farms (in particular the pile driving process) has much greater potential for causing acute effects such as physical damage and hearing loss than the operation of the facility once built (Madsen et al., 2006). The broadband pulsive noise generated during pile driving has a high source level (SMRU, 2007). Pile driving is dominated by low frequency sounds but also contains some higher frequencies (Parvin et al., 2006).

Given such intense sound production, it is perhaps not surprising that porpoise detections at the Nysted and Horns Rev offshore wind farms in Denmark decreased over considerable ranges during pile driving for wind farm construction (Carstensen et al., 2006; Tougaard et al., 2003). Such effects may well lead to significant impacts (SMRU, 2007). "Significance" has yet to be defined in the UK, but disturbance guidance is currently being developed by the JNCC. It is worthy of note that these Danish studies did not establish the maximum range at which effects could be detected and that no work has yet been conducted in the UK to try and make these sorts of measurements.

Consideration of injury as well as disturbance and habitat avoidance is appropriate. Cetaceans have highly-developed acoustic sensory systems, which enable them to communicate, navigate, orientate, forage and to avoid predators in the marine environment, where hearing is a much more important sense than vision. Sound propagation conditions in inshore waters are often between 15 and 20 Log(r) meaning that animals within ranges of several hundreds to thousands of metres of piling are at risk of Temporary Threshold Shift (TTS) (see SMRU, 2007). Lucke et al. (2007) provides the first direct evidence of effects on the hearing of the harbour porpoises and the first evidence of impacts of low frequency impulsive sounds with similar characteristics to those from pile driving on the hearing sensitivity of any cetacean. This work indicates that, even though the hearing sensitivity of harbour porpoise is low at the frequencies at which most of the airgun sound energy occurs, TTS is induced at higher frequencies. TTS is induced at very much lower received energy levels in harbour porpoise than in the other cetacean species investigated so far (SMRU, 2007). Recovery of the harbour porpoises took more than 24 hours (Lucke et al., 2007). This research has profound implications for the use of pile driving, given that porpoises are widespread around the coast lines of Scotland and, indeed, the UK.

Collision risk parallels suggest a possible risk to marine mammals from marine energy devices and it cannot be assumed just because marine mammals are highly mobile, with excellent sensory capabilities, that they will always be able to avoid a collision with tidal stream devices (Carter et al., 2008). Especially considering 1) these devices will be big (for example, the turbines of one device have a diameter of approximately 15 to 20 m), and 2) that the developers' aim is for the deployment of a number of devices in appropriate locations as 'energy farms' or arrays. The preferable sites for tidal stream devices will be restricted passages, for example, between islands and the mainland, or around headlands. Some species of coastal marine mammals are known to target these tidal stream locations either in transit or to forage (Carter et al., 2008).

Other considerations include the extent of area affected, the length of impact and the number of animals that use the site (as in Diederichs et al., 2007). Whilst injury might be limited to 100's m of the site, and to shorter time periods that may extend to weeks or months, disturbance and exclusion could extend to >30 km. Cradle to grave lifespan of a development, including construction, operation and decommissioning phases, will also cover many decades and a range of activities that include seismic profiling, increased shipping and aircraft traffic, trenching and dredging.

Species of concern

Whilst the majority of the science to date has been focused on harbour porpoises, Scotland has a diversity of cetaceans that are either seasonally or annually resident in its coastal waters, including bottlenose dolphins, minke whales and white beaked dolphins. Each of these species requires different considerations. In particular baleen whales, such as the minke whale, may be susceptible to lower frequencies that the higher frequency hearing odontocetes. In the only reported study of baleen species response to pile driving noise, fin whales avoided an area of over 200 km in the Ligurian Sea Sanctuary during pile driving activities (Borsani et al., 2007). Fin, blue and humpback whales are resident in deeper waters to the north and west of Scotland (Charif and Clark, 2009; Moscrop and Swift, 1998). Further, should minke whales, and other marine species such as basking sharks, respond in a similar manner to fin whales, this could have serious consequences for those animals that are seasonally resident in the coastal waters around Scotland, and potentially for marine wildlife watching tourism. Both of these concerns require further investigation. Assessment of impacts on resident bottlenose dolphins throughout their range along the northeast coast of Scotland may require additional investigation in the form of Appropriate Assessment under the EU Habitats Directive.

With the Scottish Government's target of meeting 50% of Scotland's whole electricity demand from renewable energy by 2020, we can expect to see marine wind, wave and tidal farms spread out along the extent of Scottish coastlines, and in deeper waters offshore as technology develops. Development on such a scale could have impacts on populations of marine species including baleen whales, such as fin and minke whales; deep diving species such as sperm whales; and white-beaked dolphins, common dolphins and white-sided dolphins, who's distributions, abundances and population trends we know almost nothing about in Scottish waters.

BEST PRACTISE

Determining what best practise for a new industry is challenging. The JNCC response to the Scottish SEA for wave and tidal power pointed out a number of steps that are required to address gaps in knowledge while assisting developers to select environmentally appropriate sites through a six stage process:

1. Gap analysis of environmental information
2. Comprehensive EIA guidance (including criteria for site selection)
3. Targeted survey work (large-scale and collaborative approach)
4. Preliminary round of development based on precautionary threshold coupled with adoption of an iterative approach to consenting
5. Structured and funded monitoring (all stages of pre-development planning, construction and operation)
6. Commitment to full, well resourced SEA for licensing rounds

The JNCC suggested that this process will need to be led and funded by the then Scottish Executive.

Marine Spatial Planning & cumulative impacts

As stated earlier, within territorial waters, marine renewable energy is a Scottish responsibility whilst it is a UK responsibility beyond 12 nm. In addition, the Crown Estate is responsible for licensing. As with other marine industries that will fall under the UK and Scottish Marine Bills, effective marine spatial planning is therefore necessary to ensure environmental responsibility across national boundaries. Collaborative and joined up thinking is required.

The proposed capacity of development may be as much as four times the eventual level built out under Rounds 1 and 2 combined. Assessment of cumulative impacts is challenging and we are pleased that Crown Estate is tackling these under Round 3. Concern over cumulative impacts may be prominent during the consenting process, particularly if construction operations on adjacent sites takes place concurrently, giving rise to the potential for longer term and geographically widespread increases in underwater noise (Prior and McMath, 2008).

Criteria for site selection
Scottish Natural Heritage (SNH) stated in its response to the SEA for wave and tidal power "the most appropriate and successful form of mitigation is to avoid sensitive sites and concentrations of sensitive species through proper strategic planning and siting of wave and tidal current devices. In that context it is important that proper spatial mapping or species sensitivities is undertaken as it has been for species in the onshore environment." Given the likelihood of displacement during construction at the very least, Natura 2000 Special Areas of Conservation (SACs) and other legislated protected areas and known sensitive and important habitats should be given consideration at this early stage.

Best practice guidance
There remain considerable uncertainties surrounding the potential impacts of marine renewable energy developments on cetaceans. Strong, clear and unambiguous guidance on marine renewable energy development is required before large scale developments are approved. Robust guidance on what sites are suitable and on the objective and required precision of pre, during and post-construction monitoring is necessary. Standard monitoring of up to several years has been proposed (Diederichs et al., 2008) and SNH has suggested that timeframes of up to 15 years of post construction monitoring may be required. A long term framework for best practise guidance, monitoring and funding of research is required.

The potential negative effects of marine renewable energy developments were first identified at the Seventh COP of the Convention on Migratory Species (CMS) in Resolution 7.5: Wind Turbines and Migratory Species. The Parties expressed concerns over the possible impact of offshore wind developments on migratory species of mammals and birds, including *inter alia* the "emission of noise and vibrations into the water. Similarly, ASCOBANS has exercised a clear remit to address the acoustic disturbance of small cetaceans. Indeed, the ASCOBANS Noise Working Group is currently considering the potential impacts of noise generating activities during marine renewable energy development. Development of best practise guidance by ASCOBANS Parties is a necessary next step before further wide scale marine renewable energy development occurs.

Investigative field research
Extensive fieldwork is needed to ensure that marine renewable energy targets are met and that the marine environment is protected in accordance with domestic and European laws and policies. Cetacean surveys must be adequate for assessing any localised and wider scale impacts. A combination of visual and acoustic surveys are the accepted method for obtaining robust assessments of cetacean distribution, abundance and density, depending upon the species of interest in preparation for a pre-construction Environmental Impact Assessment (EIA). Aerial and boat surveys and passive acoustic monitoring show the most promise for pre development monitoring. Aerial surveys may be important for multi-species monitoring and for minke whale detection as their vocalisations are rarely recognised. Passive acoustic monitoring may be a better technique for small scale, localised impacts. Monitoring of potential impacts will vary from habitat displacement (passive acoustic

monitoring and aerial surveys) to collisions (video equipment or new more dynamic techniques). Further information on survey design techniques are available (Diederichs et al., 2008).

A factor of particular relevance to collision risk with underwater turbines is the dive behaviour of marine mammals in the high energy sites in which turbines will be deployed. Telemetry studies and passive acoustic tracking may be appropriate methods for seals and odontocetes respectively.

Real-time mitigation

Careful site selection, appropriate real time mitigation and site specific surveys were all highlighted in the Scottish SEA for wave and tidal power. Untried and untested real time mitigation measures have been used in the past in the marine environment, particularly for the mitigation of intense noise pollution generated by seismic surveys (see Weir and Dolman, 2007; Parsons *et al*., 2009) and naval sonar (see Parsons *et* al., 2008; Dolman *et al*., in press). SMRU (2007) reviewed existing real-time mitigation measures for offshore wind farms and concluded that they are ineffective. As the scientific research develops, these untried and untested mitigation measures are becoming less and less acceptable, as their efficacy is questioned. As a result, it seems likely that lawful (i.e. consented) activities which incidentally give rise to disturbance could constitute deliberate or reckless disturbance.

Mitigation should be project specific, depending upon the characteristics of individual devices and the local environment in which they are installed and such mitigation should then be a requirement of the permitting process. Untested mitigation measures, including soft start or 'ramp up', and ineffective mitigation measures, such as conducting visual observations at night or in adverse weather conditions, should not be relied upon as they do not provide protection to marine species. The onus should be on the developer to prove that real time mitigation measures reduce risk to an acceptable level.

Reductions in emitted noise pollution show promise. For example, a pile driving sleeve is an option that has been investigated and could be brought into production in a short time frame (Niels et al., 2007). The report concluded that deploying insulating sleeves around piles may be both a practical and economical method of effectively reducing noise levels. Other solutions to reducing noise could include alternative pile designs such as gravity bases or "jacket" approaches (these are structures based on offshore oil platforms which use smaller piles to attach to the seafloor), although in some cases, these approaches may not be technically or commercially viable (Prior and McMath, 2008).

CONCLUSION

Scotland has an incredible opportunity in its capacity for generation of marine renewable energy. To ensure that it is a world leader, it has to be well considered and best environmental practice.

Selecting suitable locations for development is a primary consideration. Once sites have been selected, a number of factors should be considered in preparation for monitoring, including clear goals and objectives, suitable methods for understanding species density and distribution. Later, impact monitoring should include changes in density and distribution of populations, as well as changes in behaviour of individuals. Real time mitigation is a tool to be considered at the final stages of planning but its efficacy must be measured.

Conducting SEAs early in the planning stages is important and it is essential that the critical knowledge gaps that this reveals are addressed speedily with pragmatic, well-focused research programs. Concern over cumulative impacts should be prominent during the consenting process, particularly if construction operations on adjacent sites take place concurrently, giving rise to the potential for longer term and geographically widespread impacts that may cross legislative boundaries. The current sectoral approach can only fail to take into account the cumulative impacts of offshore activities. The UK and Scottish SEAs for wind, wave and tidal devices in the marine environment should be carried out in an integrated way. Finally, development of best practise guidance by all ASCOBANS Parties is a necessary next step as wide scale marine renewable energy development is occurring within the ASCOBANS region.

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