BERR | Department for Business Enterprise & Regulatory Reform

APPROPRIATE ASSESSMENT

Consultee Responses

APRIL 2008

24TH OFFSHORE OIL AND GAS LICENSING ROUND - BLOCKS 106/30, 107/21 & 107/22 (CARDIGAN BAY)

APPROPRIATE ASSESSMENT WITH REGARD TO 24TH OFFSHORE OIL AND GAS LICENSING ROUND BLOCKS 106/30, 107/21 & 107/22 (CARDIGAN BAY)

Responses specifically on the draft Appropriate Assessment were received from:

1. Countryside Council for Wales
2. The Wildlife Trusts
3. Cardigan Bay Save Our Seas Group

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13th March 2008

Dear Sir or Madam

COMMENTS ON APPROPRIATE ASSESSMENT: 24th OFFSHORE OIL AND GAS LICENSING ROUND – BLOCKS 106/30, 107/21 & 107/22 (CARDIGAN BAY)

The Countryside Council for Wales (CCW) champions the environment and landscapes of Wales and its coastal waters as sources of natural and cultural riches, as a foundation for economic and social activity, and as a place for leisure and learning opportunities. We aim to make the environment a valued part of everyone's life in Wales.

Thank you for consulting CCW on this version of the 24th Licensing Round Appropriate Assessment (AA) (dated December 2007) that assesses the implications of licensing oil and gas blocks applied for in Cardigan Bay. CCW welcomes the precautionary approach taken by BERR in concluding that, in the light of insufficient information about the bottlenose dolphin populations that inhabit Cardigan Bay, there is no certainty that the plan will not adversely affect the integrity of the Cardigan Bay Special Area of Conservation (SAC).

CCW responded to consultations on earlier versions of the AA, by the then DTI, and raised concerns about (i) an apparent presumption created by the plan in favour of subsequent oil and gas project activities, and the influence of the plan on consenting of subsequent projects; (ii) the current absence of any consenting mechanism for seismic survey works in territorial and internal waters and (iii) certain omissions from the AA relating to the features of SAC's in Wales, oil spill risk analysis and the consideration of physical and cumulative effects. We are pleased to see that, with the exception of the matter of cumulative effects assessment, each of these issues have been addressed either by direct clarification from yourselves, amendments to legislation or by amending the AA. In relation to cumulative effects assessment we are content to agree that this can be most effectively addressed once specific project information is available. However, there is considerable uncertainty as to how cumulative effects assessment can be best achieved and we would suggest that the Offshore Energy SEA should consider this issue in some detail.

At this stage we would like to offer a number of comments on the AA that we hope you will find useful in finalising the AA and for any future assessment of oil and gas activity or other energy related development with the potential to affect nature conservation in Welsh waters.

Planning Policy and Guidance

The definition of 'site integrity' in Section 3.1.1 of the AA refers to Planning Policy Statement 9 that applies to England. Planning and nature conservation are devolved matters and Welsh Assembly Government operate their own policies with respect to these matters in Wales. As Cardigan Bay SAC is in Welsh territorial waters the AA should refer to the relevant Welsh planning policy guidance (Technical Advice Note 5: Nature Conservation & Planning (1996) 'TAN5'). You should be aware that the Welsh Assembly Government is in the process of updating the current version of TAN5. It would therefore be worth referring to the draft version available on the Assembly website (http://new.wales.gov.uk/consultations/closed/plancloscons/1207763/?lang=en) which provides more detailed (draft) guidance on the application of the Habitats Directive in Wales.

Section 3.1.1 describes an adverse effect on integrity as 'likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation' and cites guidance to that effect produced by the then English Nature. We do not fully agree with this interpretation. The benchmark for the integrity test is the conservation objectives and they may not necessarily be to maintain a feature at the same conservation status as at the time of designation. This sentence should be modified to make it clear that the benchmark is the conservation objectives and the reference to the time of designation should be removed.

Information about the bottlenose dolphin populations in Cardigan Bay

The AA indicates that there is currently insufficient knowledge about the location of, and seasonal variation in, the areas used by resident bottlenose dolphin populations for breeding and foraging and that this information is necessary to understand potential adverse effects and how those effects might be mitigated.

CCW supports the approach taken by BERR and recognises the need to work closely with BERR to further develop our understanding of the importance of Cardigan Bay for bottlenose dolphin. Below we provide information about the recent work on this species in which CCW has been involved, work that CCW has planned in the near future and our views on the need for additional work to support any future assessment of energy related activities in Cardigan Bay.

CCW has supported a number of studies of bottlenose dolphins in Cardigan Bay in recent years. Information about this work is provided in the list of papers being submitted to scientific journals shown in Annex 1. Briefly, these studies have used a range of techniques to monitor bottlenose dolphin abundance and distribution, range, seasonal habitat use, health and reproductive success. This work has been undertaken on CCW's behalf by the Sea Watch Foundation who has been responsible for most of the research and monitoring on bottlenose dolphins in Cardigan Bay. They are an experienced cetacean research group that was a partner in the production of the *Atlas of Cetacean Distribution in North-west European Waters* with which you are no doubt familiar.

We are hoping to commission further studies in 2008/9 that will a) determine the seasonal distribution of bottlenose dolphins and harbour porpoises throughout Cardigan Bay, both at the population level (by line-transect survey) and individual level (by photo-ID); b) monitor changes in relative or absolute abundance; and c) further examine ranging movements of Cardigan Bay animals into other parts of the Irish Sea. However, since our resources are limited, it is likely that significant gaps in understanding of the importance of Cardigan Bay to bottlenose dolphins will remain. As with the current AA, these gaps in information may continue to make it difficult to establish with

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sufficient certainty that a future oil and gas licensing round or project in Cardigan Bay will not adversely affect the bottlenose dolphin populations.

Nevertheless, CCW is keen to work closely with BERR on the Offshore Energy SEA and on any subsequent AA or EIA that may become necessary. To ensure that information can be gathered in the most effective and efficient manner may we suggest that BERR, or its representatives undertaking the SEA, liase closely with CCW in developing a well targeted programme of data collection.

If you or your representatives would like to contact me I would be happy to coordinate a meeting between yourselves and the relevant staff in CCW.

I look forward to hearing from you.

Yours faithfully

Keith Davies
Head, Environmental Policy Group

CC Ann John, WAG
Zoë Crutchfield, JNCC
Steve Benn, NE
Kate Gillham, SNH

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Annex 1. Cardigan Bay Monitoring Projects

Measuring the abundance and distribution of small cetaceans in Cardigan Bay, Wales: Implications for the management of Special Areas of Conservation
Baines, M.E., Reichelt, M., and Evans, P.G.H.
Years: 2001
Area: Cardigan Bay SAC only
Description: description of use of two simultaneous techniques (line transect survey using DISTANCE, and photo-ID using MARK-CAPTURE) to determine distribution and abundance of two small cetacean species within a conservation management area, and how those findings can be used in that context.

Trends in abundance of bottlenose dolphins and harbour porpoises from the Cardigan Bay Special Area of Conservation, Wales (2001-2006)
Evans, P.G.H., Baines, M.E., Pesante, G., Ugarte, F., and Felce, T.H.
Years: 2001 and 2003-2006
Area: Cardigan Bay SAC only
Description: data from line-transect trips will be analyzed with DISTANCE to determine the abundance of BND and HP for each year and for all the years combined. Pictures of BND will be analyzed with mark-recapture methods and from the proportion of well-marked animals in the catalogue. The data will be statistically analyzed to find out if any trend is statistically significant.

Residence patterns, site fidelity and population structure of bottlenose dolphins in Cardigan Bay
Pesante, G., Baines, M.E., Ugarte, F., Felce, T.H., and Evans, P.G.H.
Years: 2001-2006
Area: Cardigan Bay
Description: photo-identification data will be used to assess:

- how many year round residency;
- seasonal identification trends;
- group locations;
- frequency of occurrence;
- open-closed populatios.

Distribution, encounter rates, home range and habitat selection of bottlenose dolphins in Cardigan Bay
Barba Villaescusa, Laura., Pesante, G. and Evans, P.G.H.
Years: 2001-2007
Area: The entire Cardigan Bay
Description: Analysis of 2001-2007 to describe:

- BND distribution, mean group size, encounter rate, annual and seasonal number of recognizable individuals;

- habitat selection;
- identify the known spatial range of more resident dolphins;
- compare the known ranges by gender, presence of calves and group size;

Diurnal behaviour and habitat use of bottlenose dolphins in Cardigan Bay, Wales
Beddia, Lauren., Pesante, G. and Evans, P.G.H.
Years: 2001-2006
Area: Cardigan Bay
Description: Investigation of the diurnal behaviour, including assessment of:

- annual and seasonal behavioural budget of resident populations;
- preferred areas for specific behaviours such as travelling, socializing, feeding, and resting;
- core areas and representative ranges for the above behaviours related to time of day/tidal state;
- relationship between group size, sex and presence of calves and preferred site selection.

Social networks of bottlenose dolphins in Cardigan Bay, Wales
Magileviciute, E., Pesante, G. and Evans, P.G.H.
Years: 2001-2007
Area: Cardigan Bay
Description: Examination of social networks by:

- association analyses of relationships/companionships among individuals;
- calculating connectivity measures: individuals in the network: density, average path length, clustering, degree, and 'betweenness';
- investigating assortativity of individuals by sex, vertex degree, and geographic distribution.

Skin lesions in bottlenose dolphins in Cardigan Bay, **Wales**
Pesante, G.. Magileviciute, E. and Evans, P.G.H.
Years: 2001-2007
Area: the whole Cardigan Bay
Description: photo-analysis to assess:

- presence and level of skin lesions;
- categories of skin lesions;
- distribution of skin lesions presence and type through Cardigan Bay;
- whether sex or age are factors in determining the presence and type of skin lesion;
- factors influencing skin lesion type (e.g. freshwater outputs, temperature, salinity, pollution);
- whether the distribution of skin lesion reflects the social network composition;
- whether the skin lesions change with time;
- skin lesions of individuals with long sighting histories.

Acoustic monitoring of bottlenose dolphins and harbour porpoise usage of Cardigan Bay Special Area of Conservation, Wales
Simon, M., Nuuttila, H., Reyes-Zamudio, M.. and Evans, P.G.H.
Years: 2005-2006
Area: Cardigan Bay SAC only

Description: Explanation of methods for establishing a monitoring programme using T-PODs, calibration tests and results, field-testing using visual observations & theodolite tracking. Preliminary results for usage of sites will be presented.

Habitat use of bottlenose dolphins and harbour porpoise in Cardigan Bay Special Area of Conservation, Wales, UK

Nuuttila, H., Baulch, S., Simon, M. and Evans, P.G.H.

Years: 2005-2007

Area: Cardigan Bay SAC only

Description: Relative importance of different sites to both bottlenose dolphin and harbour porpoise; seasonal patterns of variation by site and overall for the two species; repeated for diel and tidal patterns of variation.

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14th March 2008

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Comments on Appropriate Assessment: 24th Offshore Oil and Gas Licensing Round – Blocks 106/30, 107/21 & 107/22 (Cardigan Bay)

There are 47 local Wildlife Trusts across the whole of the UK, the Isle of Man and Alderney. We are working for an environment rich in wildlife for everyone.

With 670,000 members, we are the largest UK voluntary organisation dedicated to conserving the full range of the UK's habitats and species whether they be in the countryside, in cities or at sea. 108,000 of our members belong to our junior branch, Wildlife Watch.

We manage 2,200 nature reserves covering more than 80,000 hectares; we stand up for wildlife; we inspire people about the natural world and we foster sustainable living.

The Wildlife Trusts have been campaigning for many years for comprehensive legislation to achieve better protection for marine wildlife and effective management of our seas.

The UK's marine environment is extraordinarily rich in wildlife, harbouring many thousands of animal and plant species. But these species, and their habitats, are poorly protected compared to terrestrial wildlife, and under increasing pressure as marine activities proliferate and climate change disturbs the marine ecosystem. We welcome the opportunity to respond to the Appropriate Assessment (AA): 24th Offshore Oil and Gas Licensing Round for Cardigan Bay, and provide a number of points and further concerns detailed below.

General Comments

We welcome the recognition of the limited understanding of the bottlenose dolphin population in Cardigan Bay and the subsequent decision to apply the precautionary principle and not to award licenses for blocks 106/30, 107/21 and 107/22. We are however, concerned that this decision may be revisited as new data becomes available, especially in light of the proposed licensing within the Moray Firth, which we oppose (please refer to our response from the Scottish Wildlife Trust).

Cardigan Bay has been recognised with Special Area of Conservation (SAC) designation for the small and vulnerable bottlenose dolphin population (numbering 150-200 individuals), also protected in the northern part of Cardigan Bay in the Pen Llyn ar

Sarnau candidate SAC. The importance of these small protected areas for this species in UK waters itself is significant, and we were surprised that this important point was not acknowledged in the AA. Additionally, information on the diversity of species within Cardigan Bay is also lacking, despite it being home to a number of European Protected Species and other marine wildlife. Harbour porpoises are regularly encountered, along with minke whales, seals and numerous internationally important sea birds, found in the area seasonally or year round, yet little consideration was given to this species diversity in the AA.

Based on the available information and known diversity of marine species within Cardigan Bay, we believe that oil and gas exploration and development would be a substantial threat, not only to the resident bottlenose dolphin population but to the larger marine biodiversity of the site and we therefore welcome the current decision not to allow licensing within, or adjacent to, this SAC.

As the bottlenose dolphins themselves are a European Protected Species (EPS) as well as Cardigan Bay being of qualifying interest as an SAC, the two should be considered separately – the site and the species, and we would hope that this due consideration would be given in any future AA of the site, if it is to be re-visited at a later date. Furthermore, it is a conservation objective of the SAC that habitats supporting the bottlenose dolphins are maintained in the long-term and that there is no significant disturbance of the species. This conservation objective should be upheld and considered in future.

Information gaps

Whilst our limited understanding of the bottlenose dolphins in Cardigan Bay has been acknowledged, the AA does not consider the critical knowledge gaps on the effects of oil and gas development or cumulative impacts which are likely to affect both species and habitat.

Environmental assessment methods currently rely on assessment of physical damage to cetaceans to predict and assess the potential impact of (mainly noise producing) activities, such as seismic surveying, drilling and use of explosives. Increasingly, data and expert opinion show that these assumptions are erroneous and that behavioral responses at much lower sound levels and at considerable distances may potentially have a range of detrimental affects, including those considered to result in injury or death. Given the absence of evidence, the precautionary approaches that are imbedded in the EU Habitats Directive should undoubtedly be implemented.

Mitigation measures

Just as there are information gaps in our understanding of the species concerned, there are also significant gaps in our knowledge relating to mitigation measures. Many proposed mitigation measures are untested and are based upon individuals being out of the area when work commences. There is little consideration of the difficulties associated with mitigating for cetacean presence, when many species spend only a small percentage of their lives at the surface. Mitigation needs to consider the cetaceans when they are out of sight (in poor conditions, at night, when they are below the surface).

There is inadequate information available on long-term impacts and on the effectiveness of mitigation measures. Mitigation measures cannot therefore be relied upon in the AA to prevent adverse impacts, and particularly long-term impacts.

Oil spills

The Appropriate Assessment report concludes that '*an oil spill will not result in an adverse effect on the integrity of the SAC*'. Whilst the risk of a major oil spill in Cardigan Bay may be assessed in the AA as '*moderate or low',* the consequences would be devastating given the small size and vulnerability of the dolphin population and the importance of the wider biodiversity. Indeed even a small oil spill resulting from, for example, vessel fuel tank leakage, could damage the integrity of such a small dolphin population. We consider that even a low to moderate risk of even a small oil spill is too high. That '*there have been no specific studies on the direct acute or chronic toxicity of oil dispersants to seals and cetaceans*' (page 4 of SMRU report) is a further concern. In addition, the growing marine eco-tourism industry in Cardigan Bay, providing opportunities for appreciating marine wildlife (not to mention valuable employment opportunities), would also be significantly adversely impacted.

Seismic surveying

While we do not agree with the assertion that seismic presents no threats to the dolphin populations, we agree with the overall conclusion that there is insufficient knowledge of both the cetacean populations and the effects of oil and gas development (and not just relating to acoustic matters) to be sure of no detrimental effect on the populations.

Cumulative impacts

Whilst undoubtedly difficult to monitor and to measure, the combined effects of increased vessel activity, placement of various rigs, ongoing drilling and the associated installations such as pipelines, ongoing discharges of produced waste to sea and then decommissioning, add to the long term cumulative impact on the site. Such in-combination effects have not been considered in this assessment, but should be in future.

In addition, the development of other sites in the vicinity (which is not restricted to oil and gas activity), is also important to consider. There is increasing concern over cumulative effects of noise and other disturbance from leisure boating, fishing, seismic and military activities and other industrial developments. Such activities should also be given due consideration.

In conclusion

Whilst we welcome the decision not to offer licenses for blocks 106/30, 107/21 and 107/22, we note that with increased data collection this decision may be re-visited in the future and as such we provide detail of our general concerns highlighted through this AA, conducted as part of the 24th round.

Should you require further information on any of the above, or wish to discuss our concerns in further detail please do not hesitate to get in touch.

Yours sincerely

JEdwards

Joan Edwards

Head of Marine Policy
The Wildlife Trusts

Cardigan Bay SOS

Response to the 2007 BERR Appropriate Assessment with regard to the 24th Offshore Oil and Gas Licensing Round: Blocks 106/30, 107/21, and 107/22

8th March 2008

Cardigan Bay SOS

Response to the 2007 BERR Appropriate Assessment with regard to the 24th Offshore Oil and Gas Licensing Round: Blocks 106/30, 107/21, and 107/22

8th March 2008

Cardigan Bay SOS

Cardigan Bay SOS is a campaign group concerned to respond to threats to the environment of Cardigan Bay and in particular potential damage to wildlife in the area. It seeks to identify threats to this environment, to raise awareness of the nature and extent of these, and to campaign to ensure that unnecessary damage is not created by industrial or other initiatives. Cardigan Bay SOS has the additional purpose of identifying environmental threats in the area and responding to these where there is the potential for damage to sustainable tourism, an important feature of the local economy. The group is particularly concerned to protect the integrity of the marine Special Areas of Conservation (SACs) in Cardigan Bay, and the important designated species that these areas are intended to protect. Cardigan Bay SOS is an independent voluntary group with no external funding, or formal association with any industry, government or other organisation.

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Summary

Cardigan Bay SOS notes that in drawing up the Appropriate Assessment (AA) insufficient attention has been given to the requirements of the Habitats Directive to consider the wider impact on the integrity of the ecosystem. It has failed to consider findings by English Nature (now Natural England) that even small losses of ecosystems can be considered detrimental. Furthermore, the Appropriate Assessment does not relate to the published objectives for the Cardigan Bay SAC as specified in the Cardigan Bay Draft SAC Management Plan.

SOS finds no substantiated reasons in the AA that physical impacts to the SAC would be avoided or that they would be minor. The SOS response also is critical of the lack of rigour around assessment of mitigation measures for noise pollution, noting that no details of proposed mitigation measures are given and that the necessity for measures is only considered for one species, the bottlenose dolphin (*Tursiops truncatus*). SOS finds that the impact of persistent organic pollutants (including chlorinated biphenols, alkylphenols, chlorinated paraffins and organotins) and heavy metals released by exploration and drilling have not been fully researched. There is little consideration given to the potential of these contaminants to have a detrimental impact on species across the eco-system, including sub-lethal effects on long-term reproduction and immuno-suppression.

SOS also found that the potential for in-combination effects to have an impact were poorly considered given recent research documenting declines in bottlenose dolphins with increased tourism (Bejder, Samuels, Whitehead, & Gales, 2006) and the large body of evidence of the likely negative impact of climate change on cetaceans (Taylor, 2006). SOS concludes that whilst the overall conclusion of the AA against allowing licensing is appropriate, the reasoning behind the conclusion fails to fully consider the impacts of oil and gas exploration beyond noise pollution. SOS notes that the present AA allows for the potential for exploration in future years when there is increased scientific knowledge of the habits of bottlenose dolphins in Cardigan Bay, but assumes a level of knowledge of factors causing population level harm that does not exist. In the opinion of SOS this would be detrimental to the long-term future of the Cardigan Bay ecosystem and the species reliant on it.

Cardigan Bay SOS Group Response to Appropriate Assessment

PART A – The Appropriate Assessment Report: Context and Conclusions

Introduction

The 24th UK Offshore Oil and Gas Licensing Round undertaken by the Department for Business, Enterprise and Regulatory Reform (BERR) sought to determine whether licenses might be awarded to companies to explore for and extract potentially available oil and/or gas in seas around the UK. The area covered by this licensing round is designated SEA 6, and embraces certain UK territorial waters largely between Britain and Ireland. The area, for licensing and other purposes, is demarcated into numbered rectangular 'blocks', and licenses may be awarded to companies in relation to activities in particular blocks. Within the 24th licensing round the award of licenses was first considered (in 2006 and 2007) for the vast majority of the SEA 6 area. Prior to licensing an Appropriate Assessment (AA) to consider potential environmental effects was undertaken and published for this area (DTI, 2007). After consideration of the AA, 150 licenses for oil and gas exploration and development ('OGED') in the SEA 6 area were awarded. Initially, as part of this stage, it was intended to consider the award of licenses in three blocks close to, and within, a marine Special Area of Conservation located off the southern coast of Cardigan Bay (the 'Cardigan Bay SAC') (see Appendix 1). It was determined that because of particular environmental considerations that a specific AA for these three blocks alone should be undertaken. The draft AA for these blocks, Block 106/30, 107/21 and 107/22, was published in December 2007 and responses to it were invited. This report is the response of the Cardigan Bay Save-our-Seas (SOS) Group to the draft AA.

Background

The primary concern of the AA addressing the potential licensing of OGED activity in the Blocks 106/30, 107/21 and 107/22, was to determine whether such activity might be prejudicial to the environmental objectives of the Cardigan Bay SAC. The Cardigan Bay SAC is a Natura 2000 site in relation to the European Union Habitats Directive (92/43/EEC) and Wild Birds Directive (79/409/EEC) (referred to as the 'Habitats Directive'). It has been set up specifically to protect certain habitats and certain designated species. With respect to habitats, three Annex I Qualifying habitat types are identified for the site: sandbanks, reefs and sea-caves. With respect to species, one Annex II Primary Species is identified, the Bottlenose Dolphin (*Tursiops truncatus*), and three Annex II Qualifying Species are identified, the Grey Seal (*Halichoerus grypus*), the Sea Lamprey (*Petromyzon marinus*), and the River Lamprey (*Lampetra fluviatilis*). Full details of the species, knowledge of their local conservation status, and the features and locations of the designated habitats for the SAC are provided in the Draft Cardigan Bay SAC Management Plan produced by the Relevant Authorities responsible for the SAC (December, 2007).

The aim of the Habitats Directive is the maintenance or restoration of habitats and species of European importance to a Favourable Conservation Status (FCS). Favourable conservation status, for both habitats and species, is defined in Article 1(e) of the Habitats Directive. For species, the definition is as follows:

"The conservation status will be taken as favourable when:

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats,*
- *and the natural range of the species is neither being reduced nor is it likely to be reduced for the foreseeable future*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long term basis".* (See Regulation 5).

Conservation measures must be established within SACs, which correspond to the ecological requirements of the habitats and species for which the sites were designated. Appropriate steps must then be taken to avoid disturbance to species and the deterioration of habitats for which the sites have been designated. The published Draft SAC Management Plan provides detailed information about the activities and environmental factors that bear on the site, initiatives undertaken to protect the conservation status of the SAC, and management strategies to maintain this.

With respect to potential OGED activity bearing on the SAC the AA was undertaken, as is required by the Habitats Directive, to determine whether favourable conservation status might be compromised. The AA (2.3, p.6) refers to European Commission Guidance on Article 6 (EC 2000) which states that, "A likelihood of significant effects may arise not only from plans or projects located within a protected site but also from plans or projects located outside a protected site". A key consideration with respect to any such significant effects (EC Guidance, 2000) is whether they would adversely affect the 'integrity' of a designated conservation site. The AA highlights (3.1.1., p.8), English Nature's (1997) explanation that 'integrity' here implies, 'the coherence of the site's ecological structure and function, across it's whole area, or the habitats, complex of habitats, and/or populations of species for which the site is or will be classified". The AA draws attention (2.2, p.6) to Article 6 (3) of the Habitats Directive which states that, "In the light of the conclusions of the assessment of the implications for the [Natura 2000] site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the [Natura 2000] site concerned ....".

With respect to Article 6(3) of the Habitats Directive, a key judgement of the European Court of Justice has provided important guidance to the test to be applied to evaluate whether a project or plan may adversely affect the integrity of a Natura 2000 site. This is the decision made in relation to the Waddenzee case (ECJ, 2005), which specifies that a competent authority can authorise a plan or project, "only if [it has] made certain that it will not adversely affect the integrity of the site. That is the case where no reasonable scientific doubt remains as to the absence of such effects". A further question arises as to what constitutes a sufficient effect to compromise the integrity of the site – certain effects might be so small as to be viewed legally as 'de minimis', and not to be worth considering. In a review of authoritative decisions Hoskin and Tyldesley (2006) show that Secretaries of State have held that very small scale losses or changes in habitat are likely to be a significant effect. Indeed they have concluded that losses of substantially less than 1%, would be an adverse effect on integrity; or at least they could not ascertain there would be no effect on integrity (p.56). The value of each and every part of a large site is emphasised in that all parts of large areas (for example, estuaries) are potentially important because they are very dynamic, and different parts are used at differing times for differing reasons. In a further important planning decision precedent Hoskin and Tyldesley (op.cit., p.50) report that a company had argued that where there was 'sufficiency' of habitat, that this enabled a decision-maker to exercise judgement in considering whether the loss of habitat from a Natura 2000 site would be permissible. However, this was not accepted by the Inspector who stated that,

"One of the purposes of classifying SPAs is to protect a sufficient diversity and area of habitat for the conservation of particular bird species. This implies that a Member State may exercise discretion in deciding whether a sufficient area has been classified. But once a SPA has been classified, it is not open to a competent authority to permit the destruction of protected habitat on the grounds that a sufficiency of habitat would remain. Such an approach would negate the Member States original decision to classify the site, and undermine the protective regime" (3/IR 36.189).

The validity and legitimacy of the conclusions of the AA reviewed here needs, then, to be examined in the context of European legislation, EU and UK guidance of competent authorities associated with this, and in light both of the ECJ precedent of the Waddenzee case, and planning inspectorate authoritative decisions. Critically these sources imply that only where the AA demonstrates that it is beyond reasonable scientific doubt that OGED activity will not have an adverse effect that licensing for such activity can be approved. It is incumbent on the AA to have comprehensively evaluated whether this is the case, and, with respect to Blocks 106/30, 107/21 and 107/22 to have done so in a way that addresses all of the specific Natura 2000 conservation objectives of the Cardigan Bay SAC. In the light of past authoritative decisions and Habitat Directive guiding principles, it must, further, ensure that even small losses or small scale effects of relevance to site integrity cannot be anticipated were it to seek to allow OGED activity in or impinging on the site.

The Conclusions of the Appropriate Assessment

The Appropriate Assessment drew its conclusions on the basis of the assessment of potential impacts on site integrity under four main headings. These were a) oil spills (including all liquid phase hydrocarbons) (evidence reviewed in AA Appendix D); b) physical effects (e.g. trenching and placing deposits on the seabed) (evidence reviewed in AA Appendix E); underwater noise (in particular, seismic effects) (evidence reviewed in AA Appendix F); in-combination effects (e.g. cumulative and synergistic and secondary/indirect effects) (evidence reviewed in AA Appendix F). Discussion of potential for chemical contamination is addressed in the AA in connection with both oil spills and under the heading of physical effects.

With respect to the potential for oil spills impacting on the SAC, to the potential for significant physical damage, and with respect to in-combination effects the AA concludes that adverse effects will not arise for the SAC. In relation to oil spill potential the major argument presented is that natural gas is the anticipated hydrocarbon type, and that consequently a major oil spill is not feasible from operations in this area. With respect to vulnerability to physical damage, the AA acknowledges potential for this from activities such as drilling rig placement and construction, drilling and pipe-laying, but suggests that there are 'well proven methods to prevent impacts' (5.3.1., p15) (see further discussion of this point below). With respect to in-combination effects the AA states that, 'BERR is not aware of any projects which are likely to cause cumulative or synergistic effects that when taken in-combination with (other) activities would adversely affect the integrity of relevant European Sites'. It should be noted that in each of these areas these conclusions have been very substantially drawn on the basis of evidence examined in relation to cetaceans in general, and bottlenose dolphins in particular. The AA does not include any significant discussion of impacts on other qualifying species, grey seals and lampreys or protected Annex I habitat types, and in each case dismisses the potential for adverse effects on these.

Where the AA does conclude that there is a basis for not awarding licenses for OGED in the specified blocks on a precautionary basis, is in connection with the potential effects of acoustic disturbance on the bottlenose dolphin population. The grounds presented for this are that the lack of current information on the bottlenose dolphin population with respect to breeding, foraging and migration means that it is difficult to characterise potential adverse effects of acoustic disturbance (chiefly seismic exploration activity), and to consider how any such adverse effects might therefore be mitigated. The AA does not spell out what the nature of current knowledge is, nor does it indicate what particular data gaps there might be. It describes the level of knowledge in comparison with that available for bottlenose dolphins in the Moray Firth in general terms and presents this as an argument for differential treatment of Cardigan Bay and Moray Firth SACs. The AA does not suggest there are other areas of lack of knowledge beyond that relating to dolphin behaviour, with respect to acoustic disturbance that bear on a precautionary conclusion. It is interesting to note that while precaution is advised in relation to potential acoustic disturbance from seismic survey noise, that in the Conclusions section relating to this (AA 5.4, p.16) that the discussion implies that there is no evidence of significant adverse effects in any event. This is, however, at odds with the content of the relevant Appendix F, in which evidence of a number of established effects is documented.

The AA report throughout (both in the main body and in the Appendices) repeatedly emphasises the potential for mitigative measures to counter potential adverse effects in practice, stating that (AA Summary), 'the need and potential for mitigation measures to obviate or minimise the adverse effects were considered in reaching a conclusion' (p.4). Examples of this emphasis include the following:

re Marlin Regulation 33 Advice matrices relating to species disturbance: *'several* *of the "probable" effects highlighted in the matrices are not inevitable consequences of oil and gas exploration since they can be mitigated through timing, siting or technology (or a combination of these)'*. (AA 5.1, p.15).

re potential for physical damage: *'while exploration or production activities could take place in or near to coastal SACs and SPAs, there are well proven methods to prevent impacts'*. (AA 5.3.1, p.15).

re coastal sites not impinged on by blocks applied for: *'While new pipelines could be constructed to allow export of gas found in the blocks to existing infrastructure, either through or near to coastal SACs and SPAs, there are well proven methods to prevent/mitigate impacts'*.

It is also implied in the draft AA conclusion not to allow licensing of OGED in the three blocks at this time on the grounds of lack of knowledge of dolphin behaviour, that were such knowledge available then mitigation methods could be applied effectively.

In reaching its conclusions the AA provides only very brief information about possible mitigation measures and most often refers to them in very general terms. It provides no evaluation of any evidence that mitigation measures alluded to are effective in preventing adverse impacts. (A full discussion of this issue is provided later in this report). Further, at several points in the AA report evaluation of the potential of particular impacts to create adverse impacts, is 'postponed'. Later, local project or activity specific environmental assessments and (unspecified) mitigation measures at this level are appealed to without further analysis. This means that the appraisal provided by the AA is limited and difficult to assess. The AA states (3.3, p.10), however, that, 'The approach in this AA has been to to take the proposed activity for a given block as being the maximum of any application for any application for that block, and assume that all activity takes place. This more than satisfies the test of being reasonably foreseeable, and the environmental impacts of the assessments are pessimistic'. This appears to contradict the rationale for postponing so many evaluations of impact to post-AA stages.

With respect to the AA conclusions and the rationale underpinning these it is noted that this AA is intended to be specific to the three blocks bearing on the integrity of the Cardigan Bay SAC. It is not evident that significant additional evidence that is specific, beyond that provided in the generic AA for SEA 6, has been provided. Further, it would have been anticipated that the AA would have systematically related evaluations to the specific conservation goals of the site and anticipated management activities in relation to this as outlined in SAC Management Plans. The AA does not do this.

PART B – Potential for Adverse Impact: Evaluation of Evidence

Determining Population Level Effects

As indicated in Part A of this report, the key concept with respect to the goals of Natura 2000 sites and species protection within/by these is the maintenance of 'favourable conservation status' (FCS). The Habitats Directive places particular emphasis on the status and viability of populations as indicated in the definition given below (and previously on p.7 of this report):

"The conservation status will be taken as favourable when:

- *population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats,*
- *and the natural range of the species is neither being reduced nor is it likely to be reduced for the foreseeable future*
- *there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long term basis".* (See Regulation 5).

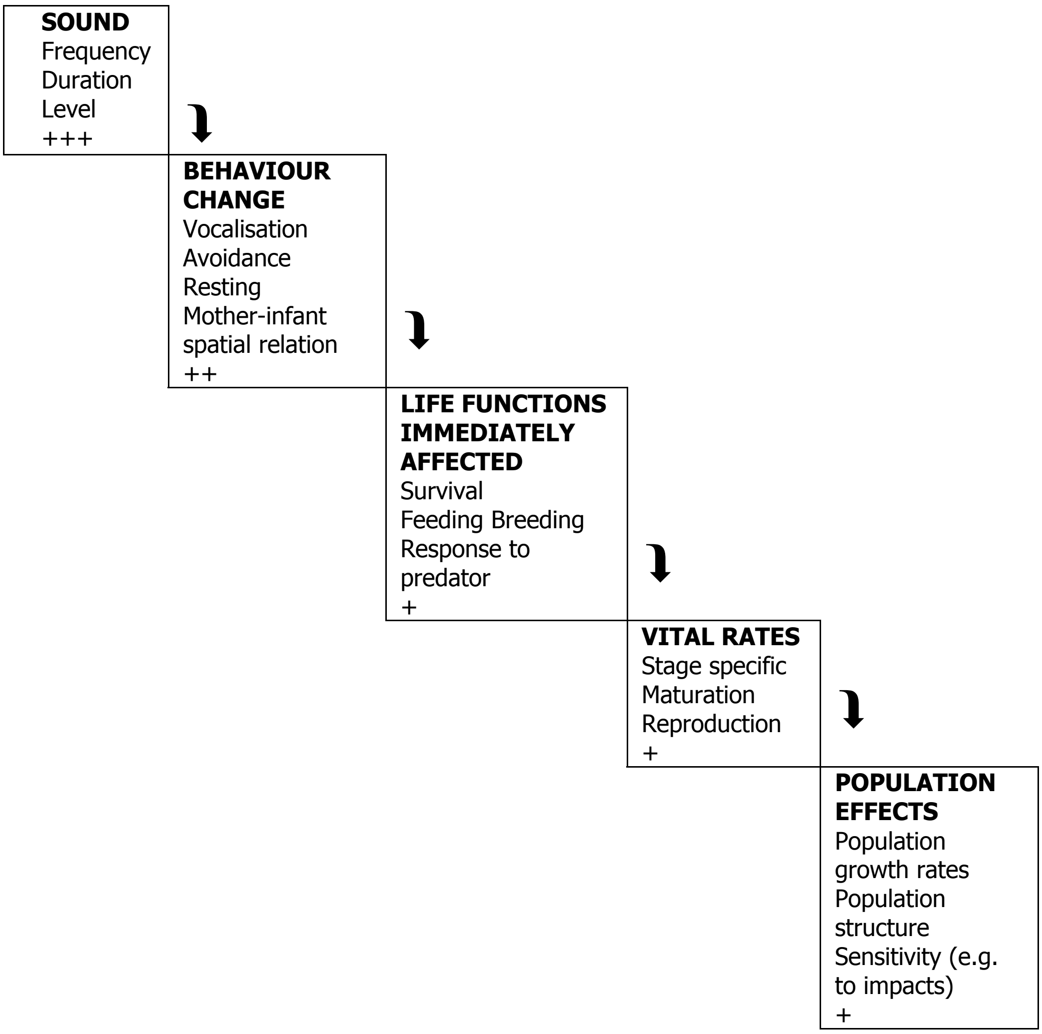
An important implication of this is that where activities bearing on a Natura 2000 Site have the potential to ultimately damage population viability (and this cannot be mitigated) that consent for such activities cannot be given (except in certain specified circumstances). The question then arises as to whether such damage is potentially caused or not.

It is very difficult to show causal relationships between particular events (such as drilling activity, spills or seismic exploration in this context) and longer term population effects. Where evidence is available in relation to activities that may bear on particular species this is, in the vast majority of cases, in terms of short-term effects such as on physiology or behaviour. In the absence of evidence that has been collected to examine population level effects, frequently inferences are made based on short-term responses, though the basis on which this is done may be unreliable.

In the U.S.A. the National Research Council has examined this issue in depth. In the most recent of a series of reports examining marine mammal populations and ocean noise (NRC, 2005) the NRC point out that many effects of human activities on individual marine mammals occur on a time scale of seconds to years, while effects on populations occur on timescales of years to generations, and effects on ecosystems on a scale of generations to centuries. Moreover, they highlight, with respect to marine mammals, an extreme lack of data concerning relationships between impacts of activities and effects at the population and ecosystem level. The NRC point out that one approach for protecting marine mammals is to monitor their populations, but that, while this is important, it is generally not possible to estimate trends precisely for most marine mammals, and by the time a decline is detected, it may be too late. In this regard, the NRC suggest that it is important 'to explore the scientific challenge of using short-term observations at the level of individuals to predict effects on populations' (p.11). As an illustrative instance of this challenge, the NRC point out that for most noise effects (on marine mammals), that the primary source of uncertainty stems from our difficulty in determining the effects of behavioural or physiological changes on an individual animal's ability to survive, grow and reproduce.

In seeking to address the 'scientific challenge' referred to above, and to provide means by which decision-makers seeking to provide protection to marine mammals can make meaningful assessments, the NRC have defined a useful framework, which spells out in general terms the relationships between impacts and effects at different levels. This framework, referred to as the Population Consequences of Acoustic Disturbance (PCAD) model, relates particular stimuli (e.g. sound), to behaviour change, this to life functions of animals immediately affected, this to vital rates within the population, and this, finally, to population effects. Each level is related to the next, 'higher' level by a 'transfer function' which is a general term describing the nature of the relationship between effects at one level and consequences at the next. An adapted version of the model is presented diagrammatically below providing some illustrative examples of variables at each level:

Figure 1. Population Consequences of Acoustic Disturbance Model (PCAD) (Adapted from NRC, 2005, p. 36)



The NRC suggest that the availability of data and how readily it can be obtained varies across levels of the PCAD model. Currently they imply that such data is not at all readily available for measures relating to life functions of individual animals affected, vital rates, and population level effects, though it is more so for behaviour change (the degree of data availability is represented in Figure 1 by + signs). The NRC also suggest that our understanding of the transfer functions which relate levels varies considerably between levels. They suggest that for marine mammal species in general that our knowledge of how behaviour change effects translate into effects on life functions (such as feeding), and how these functions translate into vital rates (such as reproduction) is very limited indeed.

In relation to the PCAD model, and reflecting the considerable areas of lack of current understanding and of data availability, the NRC have recommended in the U.S.A (NRC, op cit) that a systematic, wide-ranging research exercise be initiated using representative species from particular marine mammal taxons. This research would, for example, collect data on important biological parameters such as mortality, auditory threshold shifts, injury, avoidance and a range of behaviours with the theoretical potential to change demographic parameters such as reproduction. The NRC are particularly emphatic that such research should be 'focused' since they claim that a very great deal of the evidence that has been collected, is not amenable to enabling understanding of relationships between, for example, behaviour change, life functions and population level effects. It is anticipated that the results of such research can assist decision-makers charged with protecting marine mammals, and evaluating the likelihood of biologically significant effects of particular activities. The NRC are optimistic that the key integrative concept of the management of 'energy budgets' by animals will be valuable in developing theoretical understanding of the transfer functions (see NRC, pp. 61-62, for example).

The PCAD model and approach recognises the value of measures of short-term impacts as a basis for developing understanding of relationships between 'stimuli' (such as sound) and, ultimately, population level effects but recognises that on their own they do not provide readily interpretable evidence relating to long-term effects. Some of the most extensive evidence on behavioural effects, based on monitoring cetacean response to seismic surveys, has been provided by Stone (2003) and Stone and Tasker (2007). Stone (2003) points out in the conclusion to her report documenting these effects on species including bottlenose dolphins, that it is not possible to make inferences about long-term effects from the data. Similarly Stone and Tasker (2007) in a related study conclude, 'that although those responses that were observed were short-term effects, it is not known whether these may have been biologically significant: effects that persisted beyond the time of disturbance, responses that affected the ability of animals to engage in essential activities (e.g. breeding, feeding, caring for young, migrating, etc.), or effects that had consequences at the population level' (p. 262).

Weilgart (2007) points out that additional uncertainties are created in terms of what the lack of a short-term behavioural response might mean. If a lack of displacement associated with an activity is found the implications of this can be ambiguous. Weilgart suggests that if cetaceans are in an area they are probably there for a reason. Lack of displacement does not necessarily mean that animals are unaffected. He suggests that, 'animals may be forced to remain in an area of importance to them, despite having to endure costs such as stress, masking or even hearing impairment that would be hard to detect'. Similarly, Stone (2003) suggests that where cetaceans do not show apparent displacement over a period of time that it would not be possible to determine the meaning of this observation unless individual level identification data were available – animals might have moved and new animals have come into the area. Recently two studies reported by Bejder and co-workers have supported these concerns about interpretation of absence of immediate effects. Bejder (2005) found a reduction in bottlenose dolphin calf survival associated with exposure to whale-watching vessels, though observed short-term behavioural responses were very moderate. Bejder, Samuels, Whitehead, and Gales (2006) were able to conclude that dolphin-watching tourism contributed to a long-term decline in abundance at the impact site though observations of response to vessel traffic indicated that those exposed to traffic had reduced behavioural responses. Bejder et al interpreted this contrast in terms of selection out of sensitive dolphins from the area. It is interesting to note that the long-term effects emerged only when an experimental and control group were compared over a period of 13.5 years.

Where displacement does occur on exposure to noise Nowacek (2007) points out that in order to examine its significance it is necessary to know what has actually happened. For example, the significance of the displacement will depend on where the animals went, the quality of the habitat and the duration of the displacement if animals return, and whether animals do return. A short-term displacement, Nowacek suggests, from an important location may not be of great concern, whereas it would become so if such a disturbance happens repeatedly. Furthermore, a long-term displacement may or may not be of concern depending on the quality of available habitat. With respect to the determination of population level changes a final issue to consider is the potential difficulty in determining whether a change (such as a decline) has occurred because of uncertainties associated with measurement. In cetaceans, given their highly mobile, underwater nature and the limited extent of, for the most part, detailed monitoring only a handful of species have population estimates that are more precise than plus or minus 40% (Whitehead et al, 2000, as cited in Weilgart, 2007). Taylor et al (2007) noted that 72% of large whale declines, 90% of beaked whale declines, and 78% of dolphin or porpoise declines would not be detected under current monitoring effort, even if the declines were so dramatic as to represent a 50% decrease in 15 years. The bottlenose dolphin population using the Cardigan Bay SAC and coastal waters to Fishguard was estimated at 213 individuals in 2002 by Baines et al with 95% CI of 183-279 (i.e. approximately plus/minus 30%), and in 2007 by Evans as between 150 and 300 individuals. Clearly detection of adverse change in this population with this level of precision is problematic.

In the AA report section 5.4 addressing conclusions for European sites vulnerable to acoustic disturbance the following statement is made,

'While it is clear that seismic survey noise may be detectable by marine mammals, there is no evidence that noise arising from seismic surveys presents a risk to the viability of populations in UK waters; and specifically not within designated European Sites. This would require direct mortality, behavioural response with implications for reproductive success (e.g. disturbance at fixed

breeding locations) or reduced long-term viability (e.g. sustained displacement from foraging grounds); such effects have not been documented. In the localised areas of European Sites designated for marine mammals, acoustic disturbance associated with seismic (surveys – AA omission) is intermittent and there is no evidence that cumulative effects of previous survey effort have been adverse. Despite considerable scientific effort, no causal link, or reasonable concern in relation to population viability has been found.' (p. 16)

It is evident in the light of the preceding discussion concerning lack of knowledge of, and uncertainties in the determination of, population level effects that this statement in the AA has no substance. There is a lack of evidence on population effects and this does not allow the conclusion that there will be no adverse effects. Why there might need to be evidence relating to activity in European Sites specifically is not clear - it is moreover unreasonable to anticipate this given the timescale over which such sites have existed. Effects on mortality and long-term viability are not known and have not been studied in ways that would enable determination of relationships between survey activity and these outcomes. There is very limited evidence relating to cumulative effects rather than there being evidence that exposure over time does not result in cumulative effects (though Stone, 2003 does, for example, present some). In the limited instances where lack of displacement effects over time have been observed these are recognised to be difficult to interpret given lack of detailed information on individual animal movements. There has been very little systematic, focused research relating to the determination of population effects rather than 'considerable' scientific effort. Potential causal mechanisms in the absence of empirical data on effects have been often hypothesised, but remain to be tested. Finally, great concern has been widely expressed about potential impacts on population viability in the light of a wide range of behaviour ecological, audiological and physiological evidence applicable to both terrestrial and marine mammals, as well as other vertebrate taxa, and with respect to 'reasonable' theoretical predictions (for example, NRC 2005; Nowacek, 2007; Weilgart, 2007; Stone, 2003; Stone and Tasker, 2007; Weir and Dolman, 2007; Harwood et al, 2000; Romano et al, 2004; Evans and Hammond, 2004, Fair, P. and Becker, P., 2004 and many others).

Acoustic impacts of oil and gas exploration and development on bottlenose dolphins

Direct impacts

Popper (2003) points out that most marine vertebrate species use sound for almost all aspects of their life, including reproduction, feeding, predator and hazard avoidance, communication and navigation. He highlights the fact that in the marine environment vision is only useful over tens of metres, whereas sound can be potentially heard over hundreds, even thousands of kilometres. In the ocean acoustic energy propagates efficiently, travelling fast and potentially over great distances. Sound travels almost five times faster through sea water than through air and low frequencies can travel hundreds of kilometres with little loss of energy (Urick, 1983).

Dolphins produce loud bursts of echolocatory clicks (15-130 kHz) that function up to a few kilometres and are therefore likely to be used primarily for local exploration and capture of prey (McIwem, 2005). It has been suggested that pure tone whistles are also produced which can be used to maintain group cohesion over large distances and may be used to contact separate groups (Janik, 1997,2000; Janik and Slater, 1998). For bottlenose dolphins Janik (2000) estimated that the radius of the active space of whistles between 3.5 and 10kHz was potentially between 20 and 25km.It is uncertain though exactly what the relationship between these sound properties and dolphin social behaviour is.

Bottlenose dolphins appear to be most sensitive to sounds above 10kHz and are capable of detecting frequencies as high as 200kHz (Hammond et al, 2000). Maximum sensitivity is in the range 15-130kHz, where the hearing threshold is in the range 40-80dB. This high-frequency sensitivity is required because of their dependence on sounds of this kind for echolocation. Bottlenose dolphins appear, though, to be able to detect sound as low as 40-125Hz though sensitivities in this part of the spectrum are low (Hammond et al, op. cit.), with sensitivity being around 130dB for 100Hz sounds (Lawson et al). While generally there is very limited information on auditory sensitivity of most cetacean species (Weilgart et al,2007), quite detailed audiograms are now available for bottlenose dolphins chiefly as a result of studies on captive animals using auditory evoked potentials (see, for example, Nachtigall et al, 2004). It has become evident that not only do dolphins use echolocation methods for prey detection, communication and other purposes but that they also rely greatly on a capacity for 'passive listening'. Many prey fish of dolphins emit sounds and Gannon hypothesised that dolphins may have evolved to detect these. Gannon et al performed controlled acoustic playback of recorded calls of prey fish and found that dolphins changed their direction of travel significantly, turning towards the sound source (this did not occur for play back sounds of species that were not prey). The occurrence of echolocation was low, except following playback of fish sounds. It is suggested that once dolphins discover prey they then use echolocation to track it. This finding has additional implications for the potential impact of anthropogenic sound, particularly in the context of demonstrated masking effects (Au, 1993, see below for fuller discussion).

Probably the most significant potential sound impact from OGED on marine mammals is that from seismic survey activity. Seismic exploration can produce short duration broadband impulse sounds with high peak source levels (e.g. 220-250dB re 1μPa at 1m) (Nowacek, 2007). Seismic survey noise has the potential to travel very great distances. For example, Nieukirk et al (2004) demonstrated that seismic survey noise from Eastern Canada measured 3000 km away in the middle of the Atlantic was the loudest part of the background noise underwater. Hammond et al (2000) point out that most seismic surveys are now carried out with airgun arrays which are fired every few seconds. Most of the sound is concentrated around 100Hz, although there can be leakage of sound at higher frequencies. Hammond et al state that there is sufficient energy in the output of airgun arrays at frequencies of 200-500Hz to make them audible to odontocetes at distances of 10 to 100 km. Goold and Fish (1998) and IWC (2007) demonstrated that significant high-frequency noise and horizontal propagation is produced by seismic surveys, despite air guns generally being designed to produce mainly low-frequency sound directly downwards. They found that noise from seismic airguns dominated the 200Hz to 22kHz bandwidth at ranges of up to 2km from the source, and that even at 8km from the source seismic emissions exceeded background noise at frequencies up to 8kHz.

Sound propagation can be affected by many factors and be difficult to predict in particular contexts. For example, as well as effects of frequency sound propagation can vary with depth and density affected by temperature and pressure (Nowacek, 2007). Nowacek states that, 'The sound arriving at an animal is subject to propagation conditions that can be quite complex, which can significantly affect the characteristics of arriving sound energy'. Sound levels drop with increasing distance from the source, but sometimes in complex ways. Madsen et al (2006) in a study in the Gulf of Mexico, found that received levels can be as high at a distance of 12km from a seismic survey as they are at 2km. In a study involving 'tagged' sperm whales received sound levels from seismic survey activity generally decreased at distances of 1.4 to 8 km, but then at greater distances levels increased again (Madsen et al, op cit.).

A major focus in research on cetacean hearing, including that of bottlenose dolphins, concerns negative impacts of sound on hearing thresholds. Thresholds may shift temporarily and recover – temporary threshold shifts (TTSs), or there may be non-recoverable damage (permanent threshold shifts, PTSs). Impacts of sound on auditory thresholds are potentially very biologically significant. Even a temporary loss in hearing (TTS can last from minutes to days) can be fatal or injurious to animals in the wild if the detection of a predator or other significant hazard is missed (Weilgart, 2007). Scmidt et al (2000) noted disturbance reactions of captive bottlenose dolphins during TTS experiments. The behavioural reactions included avoidance of the source, refusal of participation in the test, and aggressive attacks on equipment. Studies have examined the extent and duration of TTS in dolphins under exposure to sound of different frequencies and intensities. For example, Nachtigall (2003) reports a study in which exposure of dolphins for 50 minutes to a fatiguing stimulus at 7.5kHz, at 179dB rms re1μPa resulted in TTS of 2-18dB at this frequency level. Recovery from the TTS occurred within 20 minutes in this case. Such studies are indicative of the potential for TTS in association with exposure to loud sound such as that from seismic surveys, though specific frequency/intensity/dolphin TTS interactions occurring under these conditions may be uncertain. An interesting, and consistent observation from TTS studies is that the greatest TTS often occurs at frequencies above that of the maximum intensity frequency in the stimulus (Nachtigall, 2004). This may have implications for auditory effects of loud, predominantly low frequency noise on higher frequency TTS in cetaceans or other marine mammals.

Seismic survey (and other anthropogenic noise) has the potential to mask other sounds. Au (1993) demonstrated in an experiment on captive bottlenose dolphins that a 15-20 dB increase in the spectrum of an imposed masking noise resulted in a drop of successful target detection by the dolphins, from a 100% correct response rate to only 50%. Under these conditions Au reported that dolphins stopped emitting sonar clicks and appeared to start guessing whether the target was there or not. Related evidence in wild populations of cetaceans where cessation of vocalisation occurred with exposure to seismic survey activity has been found in a number of cetacean species. In one study, male fin whales stopped 'singing' for several weeks under these conditions (IWC, 2007). Cessation of vocalisation or masking has the potential to be biologically significant, for example, where it interferes with cetacean calls relating to reproduction.

Cetaceans have been shown to be displaced from important habitats when exposed to noise (2007). Goold (1996) in a study of *Delphinus delphus* found a greater number of vocalisations per hour before than during seismic surveys at a distance of 5km from the source. Goold and Fish (1998) found a smaller proportion of acoustic contacts during seismic airgun emissions than when air guns were not in use at 750m from the source. In a very extensive series of studies which involved observation of cetaceans during exposure to seismic surveys over periods of many years Stone (2003) and Stone and Tasker (2007) demonstrated a wide range of behavioural effects. Sightings of cetaceans, including small odontecetes, were found to be significantly lower during periods of shooting on surveys with large gun arrays. Killer whales, baleen whales and small odontecetes were found to be significantly further away under these conditions. Typical activities of cetaceans in relation to vessels (such as bow-riding) were found to be much-reduced. During shooting there was an increased tendency for small odontecetes to swim at speed and for all cetaceans combined to alter course away from the vessel. Importantly, a significant reduction in the proportion of cetaceans apparently feeding was observed. Effects were less on site surveys and other low power surveys though the pattern of differences found for large airgun arrays (with the exception of reduced distance from the airgun) was maintained. Stone (2003) and Stone and Tasker (2007) state that, in general, small odontecetes showed the greatest avoidance activity to seismic activity.

While generalised assessments of hearing ability of a species are valuable in informing decisions about noise impacts of human activity, it is important also to recognise the significance of individual differences. This is particularly significant when considering relatively small, and vulnerable populations such as the groups of bottlenose dolphins semi-resident in Cardigan Bay or the Moray Firth. Cook (2006) found that when using auditory evoked potentials to test the hearing of 62 free-ranging bottlenose dolphins that there was great individual variation in hearing abilities of up to 80dB in hearing auditory thresholds.

Physiological effects of exposure to noise have been demonstrated though the number of studies carried out is very limited. In a study of two individuals (a beluga whale and a bottlenose dolphin) Romano et al (2004) examined levels of a wide range of physiological indicators associated with the stress response in cetaceans, such as catecholamines, aldosterone and lymphoid cell subsets (such as T-cells). Levels of each of these changed in directions consistent with stress response after exposure to seismic gun impulses which ranged from 198 to 226 dB re 1μPa peak pressure. Weilgart (2007) draws attention to the fact that sound impacts on hearing may not be the only, or most important effects of acoustic impacts on cetaceans. He suggests that it could be that non-auditory effects such as skin sensations, resonances in air sacs, vestibular responses such as vertigo, or gas or fat emboli (see Jepson et al, 2003), could cause impacts on cetaceans. While the studies of Finneran (2003, cited in NRC, 2005) of resonance in air spaces suggest that resonance effects in dolphins are unlikely the potential for direct, significant tissue damage, most likely with close exposure to high intensity sounds remains. Fernandez et al (2005), for example, has found in necropsies of beluga whales stranded in association with military sonar activities that the whales had severe diffuse congestion and haemorrhage, especially around the acoustic jaw fat, ears, brain and kidneys. Additionally they observed gas-bubble associated lesions and fat embolism in the vessels and parenchyma of vital organs. Fernandez et al suggested that the bubble formation, which can block blood vessels might have been the result of sonar exposure and may have been exacerbated by abnormal surfacing behaviours induced by the sonar activity.

Indirect impacts

An increasing amount of research has established impacts of seismic survey noise on a broad range of species throughout the marine system, including fish and invertebrates. Acoustic impacts on prey species of marine mammals are potentially of biological significance. McCauley et al (2003) demonstrated that seismic air guns extensively damaged fish ears at distances of 500m to several kilometres. No recovery was apparent 58 days later. TTS has been induced in several fish species, sometimes under fairly moderate levels of noise exposure and with fish occasionally requiring weeks to recover their hearing (Scholik and Yan, 2002; Amoser and Ladick, 2003; Smith et al, 2004). Significantly reduced catch rates of 40%-80% and decreased abundance have been reported near seismic surveys for a range of species, including atlantic cod, haddock and rockfish (e.g. Engas et al, 1993; Lokkeborg and Soldal, 1993; Skalski et al, 1992).

With respect to invertebrates, though studies are very limited, effects of seismic survey type noise have been shown. For example, in a study of snow crabs exposed to seismic survey conditions, crabs showed bruised organs and abnormal ovaries, delayed embryo development, smaller larvae and statocyst change consistent with a stress response, compared with control animals (Department of Fisheries and Oceans, 2004). Brown shrimp reared in tanks showed an increase in metabolic rate with moderate increases in continuous background noise, leading to a significant reduction in growth and reproduction over three months (Lagardere, 1982; Regnault and Lagardere, 1983). The potential for impacts on cephalopods is discussed briefly in the AA (p.59). The AA refers to a review by Moriyasu et al (2004) and the suggestion of the reviewers that no reliable conclusions can be made that there are negative impacts exist or not. The limited nature of the evidence collected to date cannot be used to infer that there are no impacts and, particularly given the critical role of invertebrates on the food web on which SAC protected species depend, the precautionary principle must apply.

Other anthropogenic sound

With respect to OGED activity there are likely to be a number of potential sources of acoustic disturbance other than that from seismic airgun arrays. One important example which has to date received little research is that of the impacts of pile-driving sounds associated with rig and other construction activity. Impulsive hammering can be loud: levels as high as 131–135 dB re 1μ Pa were measured 1 km from a hammer used for pipe installation (Richardson et al. 1995). Blackwell et al. (2003) measured sounds generated by impact driving conductor and insulator pipes for oil and gas wells. Individual pile-driving pulses generated a mean underwater broadband level of 151 dB re 1μ Pa. McIwem (2005) has provided useful data on such sounds in relation to cetacean hearing sensitivity. Auditory response thresholds of cetaceans tend to be at their lowest for pulsed sounds, and pile driving is one of the loudest sources of this type of noise (Richardson and Wursig, 1996). McIwem suggests that typical pile driver noise would be anticipated to be perceived by dolphins over 10km from the source, with loud sources having the potential to mask whistles at distances up to 40km, and echolocatory clicks up to 6km. However, McIwem suggests that directional hearing of dolphins would be likely to limit masking effects. Such effects though may be of biological significance. McIwem reports data on temporary displacement of dolphins from the area while pile-drivers are operating consistent with this hypothesis.

The impact of seismic noise needs also to be understood in the context of developments in other noise sources. Ocean background noise levels from anthropogenic sources have increased significantly and have doubled every decade for the last several decades in some areas (e.g. Ross, 1993; Andrew et al, 2002; McDonald et al; cited in Weilgart, 2007). There exist already significant noise inputs from boat traffic in and near the SAC (see Draft SAC Management Plan for details of this traffic), and noise inputs from military activity. OGED would clearly have the potential to introduce further noise sources including aerial ones.

Mitigation of acoustic disturbance effects

At a number of points in the AA reference is made in relation to potential impacts of seismic survey activity to the application of mitigation measures. An argument is presented (or implied) at such points that the application of mitigation measures would mean that potential identified adverse effects would be countered such that, in the terms of the Habitats Directive, it would be beyond reasonable doubt that adverse effects would then not occur. The particular nature of mitigation measures is not discussed in detail at any point in the report, however. Further, frequently it is implied that licenses for OGED activity need not be denied, on the grounds that mitigation measures at later, project or activity level would counter the potential for any adverse effects. In such cases, though the nature of later mitigation steps is unspecified in the AA report, appeal is made to particular regulations or guidelines which specify these. At no point in the AA report is the issue of whether there is evidence that particular mitigation measures are actually effective discussed. There is, however, considerable uncertainty as to whether advocated or practised mitigation measures are effective (Weilgart, 2007). There is also expressed criticism concerning the scientific basis of particular guidelines and regulations, and evidence that justifies skepticism that these are necessarily applied appropriately in practice (e.g. Weir and Dolman, 2007).

The three primary mitigation measures recommended are a) implementation of soft-start procedures (involving progressively increasing array sound levels over a specified period before full seismic gun activity, b) detection of animals close to airguns and implementation of measures such as shut-down, and c) time/area planning of surveys to avoid marine mammals (Weir and Dolman, 2007). The idea of exclusion (or safety) zones is a commonly advocated mitigation measure. Regulations may require that seismic activity is not commenced until observations of cetaceans suggest that there are none within a particular distance of the sound source (500m currently for the JNCC guidelines, JNC, 2004). Certain regulations (though not the UK's) also require a seismic survey to be shut-down if a cetacean enters the exclusion zone. Weilgart (2007) points out that regulations have sometimes sought to establish a particular noise level that could be the basis for such action. Such a noise level has, however, proved very difficult to determine given the range of variables that will affect it (such as species variations, individual differences in sensitivity, effects of local topography, water depth and density factors and others). Correspondingly what might represent an appropriate size of exclusion zone is problematic. Weir and Dolman (2007) in reviewing regulations show that there is a very wide range in size of specified zones internationally (where regulations exist) – from 200m to over 3000m.

Use of the mitigation tool of 'soft-start' or 'ramp up' is recommended in most legislative guidelines for the management of potential impacts of seismic activity. For example, in the U.K. prior to full airgun activity JNCC guidelines require that sound level is progressively increased over a period of 20 minutes. The assumption behind 'soft-start' is that animals will move away if the noise source is gradually increased in loudness. This has, however, never been demonstrated. Weilgart suggests that it is plausible that soft-start in some cases may do more harm than good if animals approach a sound source at low levels and then become exposed to harmful intensities before they have a chance to retreat. Weir and Dolman (2007) state that a simple 'increase volume progressively' over (say) 20 minutes prescription is not sensible. In practice arrays differ greatly in power and therefore 'ramp up' to full volume will involve a more rapid increase in intensity over time for larger arrays. They add that the ramp-up is under manual control ordinarily by ship's crew – the actual rate and consistency is likely to vary considerably from operator to operator. Weir and Dolman propose that when ramp-ups occur that they should be defined in terms of a particular intensity increase per unit of time, that the ramp-up process is computer rather than manually controlled, and that a starting intensity for the ramp-up is specified.

Current guidelines where they occur internationally, including in the U.K., require and depend on visual monitoring of the area surrounding an air gun array prior to any start up, and in some cases, as a basis for shut-down of activity or resumption of it. However, it is in practice difficult to determine with certainty whether cetaceans are present within a defined area (such as an exclusion zone) given the diving capacity of cetaceans, and difficulties in spotting them when they are at the surface in less than ideal conditions of visibility and when sea conditions are relatively rough. Further visual monitoring depends on daylight conditions and might be presumed to preclude night seismic array activity. However, while some national guidelines preclude night surveying, the current JNCC guidelines only encourage operators to undertake soft-starts 'as far as possible' in daylight hours. Weir and Dolman state that to their knowledge this advice has not been followed.

A potentially valuable tool, and one that is becoming increasingly sophisticated (see, for example, Leeder, 2007), is that of Passive Acoustic Monitoring (PAM) which holds out the possibility of detecting cetaceans present within an area without the necessity of visual monitoring. PAM relies on detecting cetacean vocalisations, however, and these cannot necessarily be relied on – the effect of survey activity itself has been shown to reduce or stop vocalisation in some cases (e.g. Goold, 1996). Further given the various influences on sound transmission underwater PAM cannot necessarily establish accurate range estimations. There are also limitations in the capacity of PAM to correctly identify species (Weir and Dolman, 2007).

With respect to the mitigative measure of time/area planning of surveys to avoid marine mammals this has particular potential to reduce or prevent impacts. A number of authors suggest that, in the context of considerable uncertainty about factors such as sound propagation, sound impacts, the potential for mitigation through operational or technological means, and in the context of uncertainties about details of life history of marine mammals that the most reasonable thing to do is to seek to ensure that marine mammals simply aren't exposed to potential acoustic (or other) disturbance especially in the context where they are protected. For example, Weilgart (2007) states, 'Reducing overall noise levels (the 'acoustic footprint') in the marine environment should be a priority. Secondly distancing noise events from biologically important areas or concentrations of cetaceans should be presumed. These two mitigative measures will probably go furthest in protecting cetaceans from anthropogenic noise'. Similarly, Weir and Dolman (2007) argue, 'Closed (ie protected) areas should be surrounded by appropriate buffer zones. They should be managed so that use of airguns is completely prohibited within and adjacent to key habitats during particular seasons or on a year round basis so that damaging or disturbing noises are not created'.

Planning on a seasonal or area basis to avoid 'sensitive' periods depends on a very thorough understanding of the behaviour of relevant species. Such knowledge of foraging, migration, distribution, reproduction and other behaviours is most often lacking to the depth necessary particularly with wide-ranging, marine species. The AA acknowledges this with respect to the bottlenose dolphin population which uses Cardigan Bay. Further issues are created by the complex ecological context within which the behaviour of a species is embedded. In the Cardigan Bay SAC there are additional protected species, and species which form components of the underpinning ecosystem. The 'sensitive periods' for such species may occur at different periods of the year, making response to one in terms of planning problematic in terms of creating impacts on another. (Appendix 2 outlines the usage of the Cardigan Bay SAC by different species for particular critical activities at different times of the year). A final point with respect to advocacy as a mitigation measure of planning around sensitive periods is that almost all behaviour of any species is likely to be of biological significance (even play activities have a function). Disturbance of a wide range of behaviours beyond those viewed as key (such as calving, for example) may adversely affect viability. This is most particularly the case for certain vulnerable and small populations, already exposed to multiple threats. Such populations are precisely those which Natura 2000 sites are designed to protect.

With respect to mitigation measures a further issue is the extent to which, in practice, they are applied as prescribed, or enforced. Weir and Dolman (2007) in their review are quite damning about this. They state that, 'There appears to be no onboard monitoring of the effectiveness of guidelines, no evaluation of the mitigation procedures and no repercussions for operators that fail to comply with the guidelines'. Weir and Dolman suggest that some research-related seismic survey activity represents exemplary practice. Such examples involve a rigorous application process, developing a variety of mitigation measures specific to the survey site, adopting a precautionary approach, based on scientific data and embracing the full range of mitigation procedures and technologies available. Weir and Dolman note that such a multi-faceted approach is not implemented for industrial seismic surveys anywhere in the world.

Weir and Dolman express concern about the effectiveness in application of procedures depending on who has been assigned to act as an observer. They emphasise the importance of full training of those who are to act as Marine Mammal Observers (MMOs), the necessity when assigned for the observer to be dedicated to this task and not to be occupied also in other ship's working activities, and for the MMO to be independent. According to UK JNCC (2004) guidelines in Cardigan Bay since 'cetacean sensitivities are high' (p.) it is a requirement that any seismic operation including site surveys should have a dedicated MMO, and that for surveys taking place between 1st April and 1st October above 57^0 latitude, that there should be two. Further it is advised that such observers should be conservation biologists or have significant observation experience. These expectations seem sensible and valuable. Whether the MMO is independent or employed by the surveying contractor may though be an issue. Weir and Dolman indicate that in their experience deviations from guidelines can be greater where an observer is employed by the surveyor, and that under these circumstances contravention of guidelines is least likely to be reported. These fears have some justification in the light of an ancillary aspect of the research of Stone (2003) who when observing seismic surveys monitored degree of compliance according to whether the observer was a dedicated MMO, a fisheries officer, or a nominated crew member. She found, for example, the following percentage of times UK guidelines for surveys were implemented depending on who acted as observer (note figures have been rounded):

Observer:	**Dedicated MMO**	**Fisheries Officer**	**Crew member**
Delay to survey if cetacean within 500m	70%	0%	0%
For large gun arrays implementation of 20 minute soft-start	93%	80%	32%
For site surveys implementation of 20 minute soft-start	31%	3%	1%

Figure 2. Percentage of occasions on which seismic survey mitigation measures were implemented according to status of marine mammal observer.

Physical effects and chemical contamination

Oil spills

The AA emphasises that, with respect to the three blocks, that exploration and production would be likely to concern gas not oil, and that major oil spills would not be anticipated. The report does, though, consider the production of hydrocarbon condensates in the processing of gas production, and the potential for spills of fuel and lubricating oils. The AA states that incremental risk arising from such spills relative to exposure from shipping is moderate or low. A 'moderate' risk is, though, presumably something to be concerned about, while even low risks of adverse effects on protected populations may contradict the precautionary principle. With respect to likelihood of occurrence the AA (p.47) indicates that there have been no large spills of condensate on the UKCS but this fails to recognise the potential impact of smaller scale spills, nor does it preclude large condensate spills from occurring in the future. The AA (p.46) refers to an ACOPS review of 15 discharges of 2 tons or more reported during 2003 attributed to offshore oil and gas installations. In reference to this the AA (p.47) states that, 'although potentially significant at a local scale, these volumes are minor when compared to other inputs of oil such as riverine inputs'. This statement makes a number of important errors in relation to risks presented to SAC protected species and habitats. Firstly, significant local effects are critical, secondly relative overall impacts do not negate absolute effects, and thirdly cumulative, small and moderate effects in the marine environment may be very important, and contribute to harmful background conditions. Taylor (2004) points out that there is concern about continued low level exposure to petroleum residues for cetaceans whose habitats contain offshore wells, and suggests that this subject has not received sufficient research attention.

The AA points out that in the event of a condensate spill that this would disperse and evaporate relatively quickly, while significant diesel spills (of say 1000 tons) would be expected to disperse in less than 8 hours. Such events (even on a significantly smaller scale than 1000 tons) would though create some risk. In the event of a spill, evaporation of oils from the sea surface can create significant difficulties for cetaceans. SMRU (2007) describe these as follows, 'Symptoms from acute exposure to volatile hydrocarbons include irritation to the eyes and lungs, lethargy, poor co-ordination and difficulty with breathing. Individuals may then drown as a result of these symptoms'(p.3). Appeal is made to the range of oil spill response resources which are required to be capable of mobilising to prioritised locations within estimated beaching times. However, again this implies some degree of potential risk to vulnerable species using the SAC. Oil spill response of this kind, moreover, is likely to imply the use (in some cases at least) of dispersant chemicals. SMRU (2007) note that there have been no specific studies on the direct acute or chronic toxicity of oil dispersants to seals and cetaceans (p.4.). With respect to impacts on habitat and other species the AA refers to a BERR study of the Braer spill which found no changes in species abundance or richness as a consequence, but acknowledges that sampling may have occurred too soon to demonstrate effects. It is concluded though that long-term (after 10 years) there were minimal remaining hydrocarbons in the environment. Though this study appears inconclusive in relation to habitat effects, the AA draws attention also to a study of a Florida barge diesel spill which found significant oil residues in sediment 30 years later with the potential for release with perturbation of the sediment.

While appeal is made to mitigative measures and the requirement for environmental assessment at project or other stages, the AA fails to provide sufficient information about the nature of mitigative measures, evidence of the extent of their effectiveness in practice, or sufficient discussion of any risks associated with mitigation approaches themselves. It is suggested that timing of activities would be a mitigation approach, but as was pointed out earlier (**p.x** this report) response seeking to avoid so-called sensitive periods for one species is problematic where there may then be consequences for others with sensitive periods occurring at different times. In any event it is implausible, were production to proceed, that it might stop and start on a frequent basis. Additionally certain risks would remain even in the absence of current production activity. In the context of the precautionary principle, even though risks may be relatively low, it does not appear to be the case that the AA has demonstrated that 'beyond reasonable scientific doubt' there is not the potential for adverse effects from oil spills even in the context where the primary hydrocarbon sought is gas.

Drilling and other contaminants

The AA report discusses the production of drill cuttings and of water-based mud additives (WBM) in relation to exploratory and production drilling operations. It describes the content of these as including rock cuttings, barite, salts, bentonite, polymeric organic substances and inorganic salts and suggests that these have generally low toxicity and bioaccumulation potential. It describes how surplus WBM may be discharged at the sea surface and the settling of particulate matter from this in the vicinity of the discharge area. The report also refers to the evaluation of chemical constituents in terms of standard hazard rating systems, and with the general conclusion that most pose little risk. It is noted though that reference to the safety of chemical constituent discharges, is not categorical about absence of potentially toxic effects. WBM additives are described as being 'mostly' categorised as posing little risk while for cement chemicals the 'majority' would be so described. It is also stated that the 'great majority' of 'most' WBM 'would be expected to be included in the OSPAR PLONOR list' (the latter suggesting that formal hazard evaluations have not taken place in some cases). In relation to the dispersal of particulates from drill cuttings, the AA indicates that concentrations at the seabed would be negligible at distances of more than a few hundred metres from a wellhead. It is presumably possible that significant particulate concentrations may occur up to several hundred metres. Questions remain about the potential for harm of a proportion of the chemicals and particulates produced in the process of drilling. It is pointed out in the AA that 'in general' harmful effects have not been found significant following discharge in the North and Irish Seas. It is not straightforward to examine the validity of this claim since no details or references are provided of any studies concerned. A question remains on reading the AA report whether 'no evidence' of harmful effects of such discharges implies that insufficient relevant evidence has been collected, or whether the absence of harmful effects has been persuasively demonstrated.

The AA reports some studies which demonstrate toxic effects such as negative effects of bentonite clay suspensions on scallops and effects on survival of *Placopecten* of bentonite and barite (AA p.57). Roddie (2000) has found the hydrocarbon content of the drill cuttings created significant toxicity for amphipods at concentrations of c.50mg kg-1 with LC50 response at c.100mg kg-1. Sediment samples taken at 65 metres from a drilling rig contained a sufficient percentage of drill cuttings for the concentrations of toxic hydrocarbons to be c.75mg kg-1 (ie a toxic level). Though Roddie did not find signficant effects of solutions of leached chemicals from drill cutting samples, the potential for toxic effects of drill cutting sediment is highlighted. Roddie's study also identified high concentrations of a range of heavy metals including Cadmium, Iron, Zinc, Barium, Lead and others in drill cuttings compared to reference samples, though the study did not demonstrate toxic effects of these with sediment exposure. An FOE report (1995) discusses a range of reported effects in the literature including toxic effects of drill cuttings on species distribution several kilometres from platforms, decreased feeding in bivalves, changes in immune responses and reduced spawning in fish and reduced colonisation and burrowing by amphipods and polychaetes in affected sediments.

As well as drilling discharges concern has been raised about produced water. A number of studies (see FOE, 2006, for summary) have shown substantially elevated levels of heavy metals with concentration of metals often exceeding that in sea water by 3 orders of magnitude. Finally, use of biocides, corrosion inhibitors, scale inhibitors and other chemicals is associated with drilling operations. Reddy et al suggest that information on the environmental effects of these is very limited though total cumulative inputs may be high.

Contamination effects of oil/gas exploration and production ecosystem components and such organisms have been argued for above. It is now well-known that as 'top', long-lived predators with substantial fat reserves that dolphins have the capacity to bioaccumulate contaminants from lower level organisms in the food chain (e.g. Pierce, 2007). Studies of the presence of, in-particular, high levels of organic pollutants (such as PCBs) and of heavy metals in cetaceans (including dolphins) are now extensive including ones that have been conducted in the Cardigan Bay area (e.g. Morris, et al, 1989; Law et al (2001). It has been increasingly demonstrated that the accumulation of POPs (persistent organic pollutants) in particular is harmful to marine mammals. For example, it has been shown that effects of bioaccumulation include depression of the immune system (eg Ross, 1995), increased risk of infection (Hall et al, 2006) and reproductive failure which can potentially affect population status (eg Reijnders, 1986). Further the WWF reports that there is considerable concern now about the potential for hearing loss in cetaceans with PCB accumulation, in the light of experimental studies of exposure in a number of terrestrial mammal species (eg Colbona and Smolen, 1996). The WWF highlight that the unique dependence of cetaceans on their auditory system for navigation and communication makes their continuous exposure to PCBs of great concern. It is of note that drill cuttings have been found to contain a number of persistent organic pollutants including PCBs (UKOOA, 2001).

While there are many uncertainties, the AA coverage of potential toxic effects of gas exploration and production activities appears partial and limited, and likely to underestimate the potential for adverse effects.

Physical effects

The range of activities involved in oil/gas exploration and production suggests the potential for significant physical effects. The AA describes a number of activities with the potential to cause physical disturbance including anchoring of submersible rigs, placement of jack-up rigs, drilling of wells and wellhead removal, production platform jacket installation, sub-sea template and manifold installation, and pipeline, flow-line and umbilical installation including placement of rock armour. While it appears plausible given these activities that there might be significant physical disturbance the AA appeals to a range of regulations and associated mitigation measures as a basis for concluding that in the three blocks adverse effects of physical impacts would not be significant. However, evidence presented in the report itself suggests that there should be concern about the extent of physical disturbance and its potential consequences. As in other areas the AA does not present evidence of the extent to which mitigation measures in practice are effective in preventing adverse effects on the environment.

The AA does not provide details of the potential scope and nature of pipe-laying though it is plausible that this could cause significant physical impacts. It is indicated that pipelines would go to existing terminals, and that 'well-proven' mitigation would counter impacts. The AA discusses the potential for pipe-laying to cause a number of effects. Following Elliot et al (1998) physical effects of seabed disturbance may include light penetration and reduced primary production, changes in sediment composition, smothering of benthos and reduction of community diversity. While arguments are presented about the likely limited effects in practice of these, the AA does report some studies which create concern. Studies cited by Newell et al (2004) and MMS (1999) showed that dredging activities (with effects assumed to be similar to those of pipe-laying) created loss of biomass that was not necessarily restored for many years. The AA acknowledges that benthic communities along rock dump areas will differ significantly from surrounding areas. Studies by Hyland et al (1994) are also reported which showed effects of particulate loading in the environment that had the consequence of disrupting the feeding or respiration of larvae, with associated significant reductions in abundance of several bottom-living taxa. The interpretation by the AA that adverse physical effects of operations would not be potentially significant appears optimistic.

In-combination effects

There would appear to be the potential for significant in-combination effects both in terms of potential interactions between aspects of any OGED activity that might occur in the three designated blocks, and between impacts created by OGED activity, and impacts from a range of other sources either currently occurring, with some likelihood of occurring in the near to medium future or both. In almost all cases the nature of potential combined effects is difficult to predict (though it may be significant and extensive) and in the light of the precautionary principle it seems clear that the introduction of OGED activity into areas bearing on the SAC should be avoided on these grounds alone. It seems strange that the AA report should devote so little space to in-combination effects, that it should be so dismissive of the extent of these, and so sure that 'beyond reasonable scientific doubt' such in-combination effects would not have adverse effects prejudicial to favourable conservation status of designated species and habitats. The draft SAC plan provides very comprehensive and rigorous discussion of a wide-range of current and potential activities impacting on the SAC, and which on rational grounds have the potential to interact negatively with aspects of OGED activity including the generation of noise, physical effects on seabed substrates and chemical contamination. It is strange that the AA does not refer to the SAC management plans in detail (though the current plan was not made available until after publication of the AA, the previous plan was available and being implemented). Activities with potential for in-combination affects with OGED impacts detailed in the SAC draft management plan include, inter-alia:

> hydraulic dredging, scallop dredging, military activities, coastal shore construction (including major sea defence works), underwater cabling and pipework maintenance, operation of powercraft, dolphin watching, effects of agricultural run-off, industrial sewage effluent disposal, industrial and industrial archeological run-offs.

Examples of descriptions of some of these impacts and the rationale for SAC management concern is provided in Appendix 2 for illustration. A very important issue is that such effects may be multiple – many of the influences operate concurrently and, in terms of potential environmental effects, in ways that clearly can overlap.

The key relevant concept that mediates between in-combination effects and survival outcomes is that of allostasis (McEwen and Wingfield, 2003). An allostatic state is defined as the sustained imbalance in the physiological mediators, such as hormones, that integrate behavioural and physiological responses to changing environmental conditions. An allostatic state can be maintained for some time if environmental resources are sufficient. However, the cumulative result of an organism's allostatic state is its allostatic load. The normal allostatic load results from the organism's need to obtain enough food to survive plus any extra energy required for activities associated with reproduction (such as mating, gestating, lactating) and self-protection. Animals can adapt to the extra demands within limits. However, if resources in the environment are insufficient, or if challenges such as disease, human disturbance, or stressful social interactions, increase the allostastic load, the animal may no longer cope and can develop pathologies or die.

With respect to the bottlenose dolphin population in particular it is evident that there is real potential for a combination of influences to create significant and sustained allostatic overload, for this to prejudice 'vital functions' (as defined in the PCAD model discussed earlier, p.12) and for this in turn to effect population viability. In-combination effects of exposure to seismic survey activity, physical disturbance of seabed, and introduction of contaminants are clearly possible with respect to potential OGED activity alone. In the context of known problems associated with PCB and other POP contamination that create physiological stresses, and in the light of the wide-range of other potential external influence described in the Draft SAC management plan it is implausible to suggest that in-combination effects may not be significant. It is salutary to consider one of the many case studies of marine mammal population decline that are now available, such as that of Bearzi et al (2004) who describe the very substantial decline of bottlenose dolphin populations in the Adriatic Sea and relate this to the effects over time of the in-combination effects of a number of variables including over-fishing, habitat damage, eutrophication and nutrient loss, and PCB accumulation.

In relation to in-combination effects it is now essential to consider the potential effects of climate change. The authors of the SAC Draft Management Plan discuss in general terms the potential for climate change to bear on the viability of bottlenose dolphins, the other protected species, and the SAC ecosystem as a whole. The Draft Plan states, 'Changes in environmental conditions can result in significant changes to the health and distribution of marine flora and fauna. The types of changes that climate change could cause in the UK are reasonably well-predicted, but the rate and extent of the impacts are uncertain. Changes ultraviolet light exposure, sea temperature, currents, sea level rises, turbidity, sediment transport, wave exposure and the frequency and intensity of extreme climatic conditions all have the potential to have an impact on the features of the SAC' (p.74). These effects can also interact with the impacts of OGED activity and the range of other anthropogenic influences impacting on the SAC described in the Draft SAC Management Plan. Meta-analyses have shown clear 'fingerprints' of global warming as range and phenological effects (Parmesan and Yohe, 2003; Root et al, 2003, as cited in Taylor, 2006). McCloud et al (2004) have shown that there already appears to be changes in the distribution of dolphin populations around the UK coast. Analysis of strandings from 1948 to 2003 found that no new species per decade were recorded in north-west Scotland between 1965 and 1981. However, this rose to 2.0 new species per decade from 1988 onwards with the new species recorded generally restricted to warmer waters, while those recorded prior to 1981 regularly occur in colder waters. In the period 1992 to 2003, they found the relative frequency of stranding of white-beaked dolphin, a colder water species, has declined while strandings of common dolphin, a warmer water species, have increased.

Quite what consequences climate change might have in-combination with other influences is difficult to predict. Taylor (2006) points out that climate change has the potential to shift or degrade suitable habitat, or to amplify other sources of degradation. The concept of allostatic load is again relevant in seeking to make appropriate decisions. It seems likely that climate change, as it necessitates adaptation, will very often increase allostatic load and may prejudice population viability particularly given rapid rates of warming. It has been suggested that in marine systems primary production is dependent on correct timing and balancing of mixing and stratification processes which respectively bring in fresh nutrients and concentrate nutrients and plankton (Soto, 2002; Scania et al, 2002). Taylor (2006) suggests that greater surface warming and increased freshwater input encourages extreme stratification, which depresses productivity, and potentially also cetacean food supply, depending on food web dynamics. If this analysis is correct then the allostatic load on the bottlenose dolphin population would be expected to increase as food sources reduce and foraging activity becomes more demanding. Taylor (2006) reports the observation of a warming-based 'regime shift' in the nature of primary production that appears to have occurred in the Baring Sea, resulting in reduced carrying capacity for gray, right and bowhead whales. Taylor acknowledges, however, that, 'of all sources of habitat degradation, trophic shift is the most difficult to study, as food webs may respond to disturbance counter-intuitively' (p. 5).

There are many other potential impacts of climate change that may bear on the viability of the bottlenose dolphin population in Cardigan Bay, and that of the other qualifying species in the Cardigan Bay SAC in-combination with other influence. For example, rising sea levels and increased storms and river flows may mobilise contaminated sediments, or expose on-shore dumps of POPs by flooding, potentially increasing contaminants in coastal waters (Taylor, 2006). Ozone depletion has the potential to worsen with possible impacts through UV exposure on immune system function though such effects are uncertain and require more study (Taylor, 2006). Changes in salinity and increased temperature have already been found to be associated with an increase in skin lesions in bottlenose dolphin populations (Wilson et al, 1999), and such changes may be anticipated with warming and increased freshwater inputs (Tynan and Demaster, 1997). An important concern also is the potential increase in the growth of toxic algal blooms exacerbated by global warming. Harm algal blooms (HABs) seem to be increasing, with possible connection to climate change, coastal eutrophication and shipping (Taylor, 2006). HABs have been connected to mortality of humpbacks eating contaminated fish (Taylor, op.cit.). The AA recognises that through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, large numbers of non-native species may be introduced to the marine environment (p.57). It appeals though, as elsewhere, to regulations (such as the International Convention for the Control of Ships Ballast Water and Sediments, see AA p.57) though it is not clear what degree of assurance can be placed in the application of this with increased shipping traffic, or how increased risks of non-ballast introductions might be addressed.

Impacts on Grey Seals and SAC Annex 1 Qualifying Habitats

As well as bottlenose dolphins the Cardigan Bay SAC is intended to provide protection also for Annex 2 qualifying species, grey seals, river and sea lampreys. It also contains a number of Annex 1 qualifying habitats, specifically reefs, sandbanks and sea caves. The AA focuses largely on impacts on bottlenose dolphins, and provides insufficient discussion of the nature and extent of potential impacts on other species and designated habitats. Grey seals, forage, haul out and breed within the SAC and are very likely to be susceptible to many of the influences of OGED that can impact negatively on dolphins. Grey Seals come ashore regularly throughout the year and spend significant time ashore during the moulting period (as is acknowledge in the AA, p.48). Animals are at risk from potential contamination by oil both as a persistent background source, and in the form of spills. As previously discussed an important potential consequence of any such spill and of other OGED related contaminants is harm to the food web, creating indirect impacts. The potential for bioacccumulation with pinnipeds is also well established and has been shown experimentally to creat important negative reproductive effects (eg Reijnders, 1986).That there is reasonable scientific doubt that potentially damaging spills with significant biological impact would not occur has been established earlier in this report (see pp. 24-27).

As is highlighted on p.59 of the AA, pinnipeds including grey seals are known to vocalise at low frequencies (100-300Hz) (Richardson et al, 1995), and are likely to have good low frequency hearing. Given the intense low frequency sound that characterises seismic airgun activity, there is the potential for interference with this communication, for masking effects, and where there is high intensity exposure the potential for TTS and even PTS shifts which are likely to be biologically significant. As discussed in relation to cetaceans, there may be also the potential for direct physical damage to tissue under some circumstances of exposure. The AA explictly recognises that seismic airgun activity is likely to be audible to seals within the SAC and over a large proportion of Cardigan Bay and the surrounding waters (p.64). The data discussed earlier in relation to acoustic effects on fish including observed displacement and reduced catch rates, and of impacts on invertebrate reproduction and tissue damage, suggests that there may be food web impacts of acoustic disturbances from OGED activity that bear on the viability of grey seals individually, and at the population level. In relation to acoustic disturbance the AA refers to the potential for overflying aircraft to cause seals to vacate pupping beaches with potential for separation of mother and pup. Such influences represent a further additive stress that may bear on population viability in combination with others. The AA states (p.64) that 'available evidence suggests that significant effects at a population level are unlikely' again making the error of confusing lack of evidence with evidence of absence of effect. Certainly biologically significant acoustic impacts cannot be discounted and the precautionary principle should apply.

The AA makes very cursory reference to the specific Annex 1 Qualifying habitats. There is brief reference to submerged reefs and sandbanks and to seal cliffs and caves (p.49) to the effect, that these are respectively not susceptible to surface oil pollution and unlikely to be affected due to wave reflection. A 1978 study is referred to as the only source in support of the latter assertion. The Draft SAC Management Plan (SAC 2007), however, suggests that both reef communities and sea caves are vulnerable to pollution either from accidental releases such as oil spills or from regular discharges (pp. 45 and 49), and also states, 'The extent and distribution of sandbanks is largely dictated by natural environmental factors, including wave and sediment movements. Offshore development such as oil and gas exploration, offshore wind farms and coastal development including coastal engineering works could be detrimental to some sandbank communities, if they lead to significant alteration of these key controlling factors' (p. 51).

The potential for negative impacts on qualifying habitats in the SAC is underestimated by the AA. More generally, the approach of the AA is to consider impacts on species and, to a minor extent, habitats in isolation rather than considering the SAC (and surrounds) as a complex ecosystem. The need to ensure that the ecosystem is maintained in healthy condition is essential for maintenance of favourable conservation status for both designated species and habitats, and of course the viability of other natural communities. In-combination effects of ecosystem changes, alterations to food-webs, long-term exposure of many features of the environment to contaminants, with potential for bioaccumulation in certain instances, are critical to viability. It needs to be borne in mind that impacts of OGED activity both during exploration and production, and subsequent to it, are likely to occur over lengthy time-scales (of many years or decades), with successive impacts with changing stages of industrial activity occurring, as well as multiple concurrent impacts.

CONCLUSIONS

Seismic survey activity has the potential to create a significant negative effect on the conservation status of the bottlenose dolphin population that uses the Cardigan Bay SAC. There is extensive evidence of dolphin hearing abilities, their capacity to experience auditory threshold shifts under particular conditions of exposure, and evidence of potential for other physical damage from exposure. There is extensive evidence of behavioural change and displacement from situations where seismic gun arrays are being used.

Studies of sound wave propagation show that sound produced by seismic airgun arrays can travel hundreds or even thousands of kilometres and have the potential to be audible by bottlenose dolphins over, at minimum, tens of kilometres. Significant uncertainties exist about the nature of sound propagation under particular topographical, sea density and state conditions and in response to other factors, making straightforward prediction of sound travel very difficult. Bottlenose dolphins rely extensively on sound for communication, for navigation, for exploration and for prey detection. This involves both active use of emitted and received sonar signals and passive listening for soniferous fish. Sound propagation has been shown to be able to mask transmitted sounds and to interfere with the potential to interfere with these functions.

Mitigation measures commonly proposed to reduce the effects of acoustic disturbance do not have an adequate scientific basis, and tend to rely on arbitrary exclusion distances and assumed sound levels. The effectiveness of mitigation measures such as exclusion and soft-start have not been demonstrated. The rationale behind certain mitigation measures remains uncertain (e.g. exclusion zones) and the operation of these leaves open clear potential for disruption of dolphin behaviour. There is evidence that measures proposed are often not applied fully, monitored, or enforced. It cannot be assumed beyond reasonable scientific doubt that adverse effects to bottlenose dolphin conservation status would not occur as a result of seismic survey activity impinging on the SAC.

The conclusion of the AA that there is insufficient information about the behaviour of the bottlenose dolphins that use the SAC to be able to prevent negative impacts to them is correct. The assumption underpinning this, though, is that were more detailed information on behaviour available that this would be sufficient to enable mitigation measures to be used. This is not the case as there are significant other information uncertainties. The suggestion that increased knowledge might allow the careful use of timing (by implication to avoid 'sensitive periods') fails to acknowledge the lack of understanding about what impacts are significant and what aren't. This strategy is also problematic in relation to the different uses that are made of the SAC at different times by different species.

The potential for significant negative impacts to be created by chemical contamination through possible spills of condensates, fuel and lubrication oils has been demonstrated. Appeal to mitigation measures leaves the potential for risk through oil spill and other contamination. The impact of chemical contamination including that involving persistent organic pollutants is particularly concerning in the light of known capacity for bioaccumulation by cetaceans, and increasing evidence of the effects of these on health, audition and reproduction. The potential for significant impacts through contamination has been disregarded by the AA, but this disregard is unwarranted - it is not beyond reasonable scientific doubt that chemical contamination through OGED activity would not adversely affect conservation status.

There is potential for significant physical effects as a result of OGED operations. These include rig placement, drilling and pipe-laying, in particular. The AA assessment of the physical effects of these is underplayed, and casts an overoptimistic interpretation on evidence that significant disruption to benthic organisms won't occur, through, for example, creation of suspended sediment, smothering of filter feeders and other effects. While these effects may be relatively localised such impacts may represent some significant degree of damage to the SAC site. The likely necessity for pipe-laying activity is particularly concerning, and insufficient information is presented in the AA about 'what and where' would be involved to transport gas from the area.

The AA fails to examine in anything other than a cursory way the potential for in-combination effects. There are very good grounds for assuming that in-combination effects, both between OGED impacts, and between OGED impacts and other influences are likely to be profound. This report discusses how increases in organismal allostatic load as a result of exposure to multiple stressors arising from in-combination effects would create very significant risks to viability, in particular of marine mammal species. In-combination effects are likely to be increased by the consequences of global warming. In relation to these difficult-to-predict interactions it is essential the precautionary principle applies. The AA tends to focus on impacts on individual species in isolation, particularly the bottlenose dolphin, rather than adopting a broader ecosystem approach. Greater recognition of the complex interdependencies that maintain ecosystem viability is needed.

The AA report persistently interprets a lack of evidence of an impact as implying that there would be no impact. This does not follow. This error is made at a number of points in the report in terms of the potential for population level effects. The National Research Council (NRC, 2005) in the USA and the UK JNCC (2007) have highlighted the extreme lack of evidence about population level effects on cetaceans, and the very great difficulty of establishing relationships between short-term effects (such as displacement or the lack of it) and longer-term population level consequences. This lack of understanding of relationships that bear fundamentally on conservation status argues very strongly for the adoption of the precautionary principle.

The AA report frequently refers to mitigation measures and regulations that may bear on the use of these. It also at many points does not consider a particular potential impact in depth, deferring this for consideration by later project or activity assessment. In general the AA fails to provide adequate detail of mitigation measures and assumes that these are effective. At no point is evidence provided about the demonstrated effectiveness of mitigation measures. In the absence of such evidence it would have to be concluded that where these were applied that it would not be beyond reasonable scientific doubt that an adverse effect on conservation status would not occur.

The AA was intended to apply to the potential licensing of OGED activity in relation to three specific blocks bearing on the Cardigan Bay SAC. It is very concerning in the light of this that the AA fails to relate discussion to the particular status, goals and management activities for the SAC as described in the Draft SAC Management Plan (2007) or the previous plan published in 2001. The SAC Plan provides extensive discussion of activities that bear on the site that relate to in-combination effects and these should be considered.

The AA report provides only very limited discussion of other protected species in the SAC and of the Annex 1 qualifying habitats. Since the AA is concerned with the conservation status of all designated species, and habitats and the SAC sustaining environment overall this is inadequate.   The grey seals that use the SAC Site are likely to be subject to very similar threats from OGED activity to those of bottlenose dolphins and no case has been made to the contrary. These include similar threats from potential seismic survey activity (greater in some respects because of low frequency sound sensitivity), threats by chemical contamination and seabed disturbance, and threats in relation to these to prey availability. The SAC Draft Management Plan also gives some grounds for concern about potential impacts on Annex 1 habitats most particularly from potential contamination through spillage.

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Addendum

Potential Impacts of Oil and Gas Exploration and Development on Sustainable Tourism in Cardigan Bay

The AA represent an assessment of the potential environmental impact of OGED on the Cardigan Bay SAC and its brief does not strictly extend to economic issues relating to licensing in the 24th Licensing Round. However, Cardigan Bay SOS wishes to draw attention to the importance of tourism, and increasingly eco-tourism to the area, and the potential for this too to have an adverse impact as a result of environmental damage to the area. SOS note that licensing decisions are potentially concerned with economic issues as well as environmental ones, though under the Habitats Directive, in relation to Natura 2000 sites, these issues are given priority only where there are matters of assumed overriding public interest that warrant this.

SOS presents here some data about tourism in Wales which highlights how significant it is economically, and expresses the view that OGED has the potential to create a significant negative impact on this industry in the Cardigan Bay area.

Welsh Tourist Board figures for 2005 show that:

- tourists spend over £8 million a day on trips to Wales
- this amounts to £3 billion per year tourism revenue
- £123 million was spent by tourists to the Mid-Wales coast
- visitors to the seaside have a higher average spend than those visiting urban areas
- in direct terms, tourism contributes 3.7% of whole-economy value-added in Wales. It is important to note that this figure does not include indirect value added that occurs.
- Approximately 100,000 people in Wales are employed in tourism, about 9% of the workforce.
- The UK accounts for 93% of tourism trips to Wales
- 70% of UK tourists to Wales come for a holiday
- over one million trips are taken to Wales annually by overseas tourists
- 50% of trips by UK tourists to Wales go to the countryside or small towns/villages
- the most popular activities undertaken by tourists in Wales are walking, swimming, visiting historic attractions such as castles and visiting museums and galleries.

Appendix 1

Sources of potential adverse impact on SAC drawn from the Draft SAC Management Plan

Some examples are provided below of current and anticipated activities occurring in the Cardigan Bay SAC that have the potential to contribute to in-combination impacts on the environment with other influences including OGED activity. These activities, along with others, are outlined in the Draft Cardigan Bay SAC Management Plan (2007). A number of brief extracts from this document are given below which relate to how such activities may impact on the SAC.

Education and Information

'Increased awareness about the features of the site may result in a high demand to see them in their natural environment. At sea this may lead to a greater level of recreational boating traffic and increased demand for visitor passenger boat trips with potential impacts on bottlenose dolphins and Atlantic grey seals'. (SAC,2007, p.77)

Coastal Developments

'Coastal developments, especially those that relate to harbours and foreshores have the potential to have a variety of significant impacts on the features of the site. The scale, location, timing, construction methods, and operational requirements of the development will determine the degree of impact on each of the features. There are potential impacts both during and post construction. Intertidal and subtidal communities and species may be directly impacted by the structures themselves or the construction works (e.g. use of heavy plant), and there may be changes to and sometimes loss of, existing habitats. Marine mammals may be affected by noise and possibly vibration generated during development, as well as changes to the habitats they rely on. Any physical modification of the shoreline, built or natural, may act to alter the transport of sediment and change wave reflection. This may cause alterations to the environmental characteristics influencing the adjacent shore and intertidal communities. Suitable sediment supply is particularly important for some habitats or species e.g. the reef-forming honeycomb worm *Sabellaria alveolata' '.*(SAC. 2007, p.79)

Dredging and Dredging Disposal

'Potential effects include loss and or disturbance of habitats and species. The physical effects include visual, noise, abrasion, smothering and displacement with associated knock-on biological effects. Elevated suspended sediments (and possible contaminants) can also affect benthic fauna'. (SAC. 2007. p.81)

Cables and Pipes

Cables emitting electro-magnetic fields may modify the natural behaviour of mobile marine wildlife species with potential implications on food availability and site use by species features.

Prior to installation, operators will need to survey the sea bed to establish ground conditions and determine routes. Such surveys are directed at the sediment surface using sonar equipment. Cables and pipelines may be laid across the surface of the seabed but are more usually laid in a trench. The excavation of trenches would result in damage to benthic habitats at the site of excavation, and would also be likely to result in temporary increases in turbidity and sediment load in the water column. The extent, severity and longevity of the potential effect on SAC features will depend on the nature and scale of the operations and type of seabed being affected. Fractures to pipelines can occur which could lead to an oil pollution incident inside or outside of the SAC. This may lead to impact on SAC features, either directly as a result of oil contamination or indirectly from dispersants and the action of clean up operations. There is also the potential for issues arising from the infrastructure associated with the installation and long-term management of cables and pipelines. This may include noise and sediment disturbance and increased risk of pollution incidences.(SAC 2007. p.83)

Recreational boat activity

'It is accepted that recreational use of these coastal waters will continue, and is likely to increase in the coming years. It is also clear that there is the potential for recreational vessels to have a significant impact on the dolphins and seals and an impact may currently be present of which we are unaware.

Vessel activity on the sea increases levels of noise within the water column. This may disrupt the ability of marine mammals to communicate, navigate and hunt prey. Boat activity close to dolphins and seals may result in an avoidance response where the animals cease their current activity and move away from the vessel. If disturbance is persistent this can affect the animal's energy budget and in the long term result in reduced health and/or displacement. An increase in boat activity and/or reckless speeding may result in inadvertent collision with dolphins and seals'. (SAC 2007.p.94)

Military Activity

'Explosions in the sea or adjacent to its surface may result in injury or death to marine mammals in the near vicinity. Objects 'falling from the sky' may cause injury. Disturbance may result from sudden bursts of underwater noise and the use of helicopters and RHIB when testing materials are recovered. Tests involving the use of active sonar may result in local disruption of marine mammal communication, navigation and feeding. There is also a risk of entanglement and ingestion of foreign objects in the sea resulting from military activity. The presence of toxic materials and their leakage from munitions or targets used in the Cardigan Bay sea area may result (or have resulted) in increased contamination of marine life. Bottlenose dolphins and seals are particularly at risk from any bio-accumulating substances present. There are targets anchored or moored to the seabed within the SAC. Anchoring and moorings may cause physical damage to certain marine communities depending on the location and communities present. The scour caused by mooring chains may disturb sediment communities within a localized area'. (SAC. 2007, p104)

Appendix 2

Use of Cardigan Bay SAC by Different Species Throughout the Year

Month	Species	Using Cardigan Bay for
January		
February		
March	Razorbills, Guillemots, Gannets, Puffins, Kittiwakes, Manx Shearwaters	Return from migration
	Sea Mackerel	Spawning
April	Bottlenose dolphins	Early calves
	Sea Mackerel	Spawning
May	Razorbills, Guillemots, Gannets, Puffins, Kittiwakes, Manx Shearwaters	Lay eggs
	Shags, Cormorants, sea gull sp.	Nesting
	Sea Mackerel	Spawning
June	Shags, Cormorants, sea gull sp.	Fledglings
	Sea Mackerel	Spawning
July	Shags, Cormorants, sea gull sp.	Fledglings
August	Grey seals	Return to area
	Leatherback turtles	Feeding in area
	Bottlenose dolphins	Calves in area
September	Grey seals	Pupping
	Bottlenose dolphins	Calves in area
October	Grey seals	Pupping
November	Grey seals	Late pups
	Wild Salmon	Spawning
December	Wild Salmon	Spawning