

Submission to SEA public consultation from Shay Fennelly 35 pages.

10 May 2006

Petroleum Affairs Division

Department of Communications, Marine and Natural Resources,

Leeson Lane,

Dublin 2.

Dear Sir/ Madam,

I would like to submit the following observations for the first Strategic Environmental Assessment for the Slyne Erris and Donegal Basins.

I attended the public consultation in Galway and was very surprised at the very low level of public participation (8 people?). I believe the lack of information in the press, radio and TV explaining in advance what exactly a SEA is, was the reason. While the press was used to advertise the public consultation very few people understood what it was all about. I was also shocked at the lack of attendance by university staff/students/researchers.

The public can hardly be expected to participate in a public consultation if they are not made aware beforehand what it is about and why a public consultation is being held. The low level of participation reflects the failure in this public consultation to promote and raise public awareness.

The conclusions (11.4) of the draft environmental report states, "the potential for environmental impacts has been assessed through the SEA process and summarised in this environmental report. On the basis of the assessment conducted, no licensing constraints, either spatial or temporal, have been proposed at this stage."

I disagree with these conclusions and suggest that the public consultation was a failure. It did not adequately promote and make publicly available sufficient information on what a SEA is about.

The conclusion in this draft report that the "potential" for environmental impacts has been assessed may be partially true, but the environmental impacts of various human activities in the IOSEA area have not. They are being ignored. No research has been proposed or carried out in the IOSEA area on the environmental impacts caused by seismic surveys and military sonar on cetaceans and no baseline survey of large whales, the species internationally recognised as being most vulnerable to these activities, has been carried out. The draft report conclusion is, "business as usual". Seismic surveys and the use of military sonar are gross sound pollution in the sea. They are implicated in causing disturbance and physical damage to cetaceans. The first requirement to assess the environmental impact of either activity, which cannot be understood otherwise, is to know what whales are in the area, where they are and why they are present.

As a prerequisite prior to licensing new areas for oil and gas exploration, an effective monitoring program is required before an assessment can be made of either seismic surveys or the use of military sonar impact. I suggest a research program of cetacean monitoring in the IOSEA is essential if Ireland is to implement the Habitats Directive

in the marine environment. The extent and impact of sound pollution from seismic surveys and military sonar needs to be recognised and not ignored. Research is required to understand its extent and what will be affected by this sound pollution. The polluter pays principal should be used to fund the research work.

The mitigation measures proposed must include a baseline survey of whales in the IOSEA and research on the impact of seismic surveys and military sonar on whales if Ireland is to meet its conservation obligations. Licensing seismic surveys and ignoring the impact on cetaceans is unlawful and in breach of the Habitats Directive.

The Habitats Directive (92/43/EEC) obliges the government to introduce a regime of strict protection for whales and dolphins in Ireland's marine territory. The Minister for the Environment and Marine are obliged by law on behalf of the people of Ireland to prohibit deliberate disturbance during breeding and migration and prohibit the deliberate destruction of their breeding sites and resting places. The draft environmental report nowhere acknowledges the gross sound pollution of the sea that seismic surveys and military sonar represent. No historical record is given of seismic surveys in Irish waters.

I attach additional information, as a submission to the SEA consultation, concerning seismic surveys and military sonar and their effects on cetaceans. I also include as a point of information previous submissions to the government (from 2000), in relation to oil and gas exploration in the Slyne, Erris and Donegal basins, on the issue of seismic surveys and a baseline whale survey which remain unaddressed. Also included are two recent information papers on seismic and military sonar impacts.

Yours sincerely,

Shay Fennelly

Photojournalist

Kilmeena,

Westport,

County Mayo.

ADDITIONAL INFORMATION FOR SEA SUBMISSION BELOW

- 1. IWDG SUBMISSION ON EEI OFFSHORE ENVIRONMENTAL IMPACT STATEMENT TO THE DEPARTMENT OF MARINE AND NATURAL RESOURCES, DATED 20/12/2001**
- 2. SUBMISSION 21/2/2002 ORAL HEARING –AN BORD PLEANALA GAS TERMINAL - SHAY FENNELLY**
- 3. Letter to EU Environment Commissioner 2002 regarding the Irish Governments neglect of marine conservation of cetaceans in Ireland**
- 4. Seismic testing and the impacts of high intensity sound on whales**
- 5. Military Sonar May Give Whales the Bends, Study Says**
- 6. BACKGROUNDER:SEISMIC SURVEYS AT SEA**

1.

IWDG SUBMISSION ON EEI OFFSHORE ENVIRONMENTAL IMPACT STATEMENT TO THE DEPARTMENT OF MARINE AND NATURAL RESOURCES, DATED 20/12/2001

1.1 OBSERVATIONS ON ENTERPRISE ENERGY IRELAND OFFSHORE ENVIRONMENTAL IMPACT STATEMENT

1.2 The area in which the work is proposed forms part of the Irish Whale and Dolphin Sanctuary (declared in 1991 by the Irish Government)), the first such sanctuary ever declared in Europe.

1.3 Enterprise Energy Ireland Limited propose to develop the Corrib Gas field off the coast of Mayo with its co-venturers Statoil Exploration (Ireland) Limited and Marathon International Petroleum. It is the first significant petroleum development off Ireland in over 20 years. The field when developed is estimated to produce gas for 15 to 20 years and is valued at over £2 billion pounds.

1.4 The Corrib Field lies 3000 metres below the seabed and 65 kilometres west of the Mullet peninsula in County Mayo. Enterprise Energy Ireland propose to put in place eight well heads on the seabed joined by a pipeline which will carry the gas to a mainland landfall at Dooncarton and 7km inland to a gas terminal at Bellanaboy Bridge.

1.5 An Offshore Environmental Impact Statement has been published by EEI, 21/11/2001, which aims “to identify and predict any impacts of consequence, to describe the means and extent by which the impacts can be reduced or lessened and to interpret and communicate information about the impacts” (page 4 of 43, Environmental Impact Statement) through an EIS.

1.6 Environmental Impact Statement means a statement of the effects, if any, which proposed development, if carried out would have on the environment. (S.I. No.349 of 1989, European Communities (Environmental Impact Assessment) Regulations, 1989.

1.7 The Irish Whale and Dolphin Group are concerned with the impact of this development on cetaceans and would like to draw the DOMNR and the Marine License Vetting Committee to the following issues.

2. HISTORICALLY SIGNIFICANT WHALE HABITAT

2.1 In Section 7.3.1.5 of the offshore EIS states “the waters off the north-west coast of Ireland have historically been important habitats and supported two whaling stations in County Mayo in the period 1908-1923.” The main species taken by the whaling stations were fin whales, sei whales, blue whales, sperm whales and right whales.

The fact that two whaling stations caught over 800 whales off the Mayo coastline identifies the significance of the habitat off this coast to whales. Based on the whale catch figures it was the most important area off Irelands coast for whales. Apart from sperm whales which were caught near the Rockall Bank, whaling records suggest the other species of whales were caught less than forty miles off the Inishkea Islands.

There is evidence that some of these once over-exploited species are recovering with sperm whales increasingly stranded on the Irish and British coasts and increased sightings of humpback whales. In spite of the clear significance of the marine habitat off the coast of Mayo for whales earlier in the century, no data is presented on its present significance for whales. If this research had been undertaken when oil and gas exploration began in 1994 off County Mayo the data would now be available.

While we accept assessing population abundance and status of whales is difficult, an attempt at a “systematic integrated evaluation” of the impact of the proposed development on whales is not represented in the EIS.

3. WHALE AND DOLPHIN SURVEYS RESULTS NOT IN PUBLIC DOMAIN

3.1 Reference is made in the Offshore EIS to work commissioned (page 7-19) by the Atlantic Frontier Environmental Network (AFEN) of a study of baleen whales in the waters around Britain and Ireland (October 1996-September 1997 JNCC Report No.313).

3.2 This monitoring was conducted using military hydrophones and the precise locations of the whales monitored in this study have not been made public and have not been presented in the EIS. Even though a similar study in the Pacific Ocean has published the locations of Blue whales on its public Internet website. It has already been established historically that the area is significant whale habitat. Dr. Christopher Clark, the scientist in charge of the SOSUS whale acoustic study has confirmed whale detections were made in the Erris shelf area (*pers. comm.* S. Fennelly 1/6/1998)

3.3 No pre-impact baseline survey was carried out in the Corrib field prior to seismic surveys in 1994 and exploration drilling development which started in 1996. A limited IWDG survey was made in 1993 (Gordon et al. 2000), to encourage the development of marine ecotourism, which remains the only contemporary information available at the proposed site. No research has been commissioned into the impact of seismic surveys on cetaceans in this significant whale habitat.

3.4 No results from the cetacean survey (July 1999- August 2000) commissioned by the Rockall Studies Group oil exploration consortium, which focused on the Porcupine Bank, Erris/Slyne Trough and the Rockall Trough, have been published or presented with this EIS, which precludes any interpretation of the information gathered.

3.5 The EIS acknowledges seismic surveys elicit avoidance responses from whales (see APP 2.1-12). Disturbance has already occurred from seismic surveys and

exploration drilling. The absence of any pre-impact baseline survey prior to these activities makes it impossible to assess the effects on the whales and dolphins in the area.

3.6 Assertions that, it is unlikely that cetacean species would have been physically damaged by EEI seismic operations (Impact on Cetaceans App2.1-12)... and that seismic surveys during June/July 1997 August 1997 are unlikely to have had a significant impact on the cetaceans in the area, are undocumented assertions.

3.7 No research work has been carried out on the effects on cetaceans of the numerous seismic surveys from 1992-2001 off County Mayo and in Irelands offshore waters. For example in 1997 there were 14 surveys and in 1998 five different seismic surveys were licensed, mainly in the Rockall Trough, by the Petroleum Affairs Division.

3.8 No scientific assessment of the impact of extensive seismic surveys has been carried out in Irish waters regardless of international scientific opinion that seismic surveys affect cetaceans, fish, and plankton.

The argument presented in the EIS appears to be “seismic surveys have a significant effect, but only if its documented scientifically”. As this has not been done, the conclusion in the EIS is seismic surveys have no significant effect, despite lack of data to support this conclusion.

The introduction of noise into the marine environment may have significant impacts on marine species and ecosystems. The International Law of the Sea Convention recognizes noise as a form of marine pollution and obliges states to protect the marine environment from acoustic pollution, to prevent it occurring, to act with precaution, and to carry out assessment procedures before carrying out new activities. To fully address the adverse effects of noise pollution on the marine environment, it will be necessary to look at the long-term impact on species, ecosystems and habitats. (Acoustic Pollution in the Oceans, the Search for Legal Standards H.M.Doting, A.G.O.Elferink 2000.)

4. OFFSHORE

4.1 (Page 7-20.) The EIS states, during a 1997 seismic survey sightings of cetaceans were made. Large numbers were observed periodically, but no data is presented in the EIS. It appears that species identification was not made and that the data was sent to JNCC in the UK even though Duchas, not JNCC, are the agency responsible for nature conservation in Ireland.

4.2 (Page 7-21.) CRC are to produce information on seasonal feeding and calving grounds - where is the data? It has not been published and is unavailable for examination. The offshore area is stated as important for cetaceans but this is not reflected by mitigation measures to reduce the impacts of seismic activity.

4.3 (Page 7-21.) Enterprise will monitor, but no baseline is presented.

5. BROADHAVEN BAY

5.1 (Page 7-29.) It is stated no large whales were recorded in the inshore areas through which pipeline is routed. Was the area surveyed? If so why is the data not presented in the EIS?

5.2 (Page 7-29.) "Surprising absence of harbour porpoise or bottlenose dolphin" Without more information on survey effort and on factors that affect efficiency, such as sea state, it is difficult to interpret this data. It is stated to be "based on available information"; but without an indication of survey effort, more information may well need to be obtained.

5.3 (Page 7-29.) The EIS admits the current data is limited, but a conclusion is made on the basis of it that there is no evidence that Broadhaven Bay is of particular importance to cetaceans.

6. NOISE

6.1 (Page 7-49-50.) Recognises that underwater sound can affect cetaceans, include driving them away, but no long-term effect is expected. Where is the evidence?

6.2 (Page 7-53.) Underwater blasting may affect cetaceans, but mitigation is to use a semi-submersible rig. Continued observation of marine mammals will be carried out, but there is no detail of the proposed method to be used during this monitoring, such as minimum safe distance for cetaceans, observer routine, data to be collected, procedures etc or who is to carry out this work.

7. MONITORING

7.1(Page 7-60.) An Environmental Management plan is welcome, the IWDG would expect to be consulted and contribute to such a plan.

7.2 Broadhaven Bay Monitoring programme is also welcome, but what will be the baseline data for such a scheme? A minimum of 12-months of study should be done prior to operations.

7.3 How will compliance be monitored and enforced?

7.4 Overall, the efforts of Enterprise oil in considering cetaceans in Broadhaven Bay in the revised EIS is acknowledged and welcomed but why was this not done 12 months ago and pre-impact baseline surveys funded? The same baseline and survey effort is not evident for the offshore component.

7.5 The IWDG look forward to contributing to the EMP and would hope Enterprise Oil will provide the necessary funds for full participation.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 EIA/EIS should be undertaken prior to development, not prior to production. The granting of a petroleum lease to Providence Resources on 1st May 2000 without prior completion of an EIA and EIS is a failure by the Irish Government to meet its obligations under the EIA Directive (85/337/EEC) as amended by Directive 97/11/EC

8.2 The first Offshore EIS published by EEI in spring 2000 was subsequently withdrawn due to inadequate information. This second offshore EIS published in

November 2001 has no data presented of cetacean studies undertaken. The work to assess the acoustic impact of the development works, which is clearly needed, has not been commissioned. This is not adequate. Oil and Gas Exploration should not be exempt from EIA. The exploration phase is an intrinsic precursor to all subsequent development of marine oil or gas reserves.

8.3 High mercury concentrations have been reported in the livers of cetaceans from the Irish Sea. The levels reported in some cases are within the range considered to be potential detrimental to the health of marine mammals (Ireland's Marine and Coastal Areas and Adjacent Sea, An Environmental Assessment, 1999). EEI propose to discharge effluent into Broadhaven Bay, including mercury. If the discharge is licensed any bio-monitoring program should include examination of stranded and caught cetaceans for heavy metal contamination.

8.4 Research should be commissioned, on the impact of seismic surveys on cetacean species in Irish waters, and post-mortem studies of stranded cetaceans along the western seaboard should be funded with a view to assessing evidence of acoustic damage to cetaceans in the area. (Post-mortem examination of the inner ear of stranded cetaceans should be funded.)

8.5 The Petroleum Affairs Division of the Department of Marine and Natural Resources claim (*pers. comm.* to S. Fennelly, reference letter 1997, PAD B2/2) the Environmental Division of the Department of Marine and Natural resources has responsibility for all marine environmental matters. The Department has yet to publish marine environmental protocols for offshore oil and gas exploration. Clearly the protection of the marine environment is neglected and needs to be given a higher priority.

9. THE UNDERWATER ACOUSTIC ENVIRONMENT OFF MAYO

9.1 Human beings are visual creatures. Most people, unless physically unable to see, use light to understand their environment, to orientate themselves in the world. We perceive the world with light. We even use the language of light - colours or visual images to think. For example, the phrase "seeing is believing", illustrates a tendency to believe that what we don't see is not present.

9.2 It is recorded in the Offshore EIS report (CRC 2000, Mackey et al 2000 page 7-29) that because scientists off Erris Head did not see minke whales on the day or days that the scientists were present, that minke whales were not present. It is suggested based on current data there is no evidence that Broadhaven Bay is of particular importance to cetaceans. Yet no data is presented to support this. Absence of evidence is not evidence of absence. The cursory visits made during the CRC survey can hardly be the basis for this scientific assessment. The absence of dolphin records is not surprising given the absence of scientific observers in the area.

9.3 IWDG have published evidence (Gordon et al. 2000) that minke whales use Erris Head as a feeding area and local knowledge suggests Broadhaven Bay may be used as a calving and nursery area from several years of visiting the area. Their presence has been observed and they have been seen by local fishermen in summer in the area. The bathymetry and biological dynamics around Erris Head attract Minke whales to that area. No research has been carried out in Broadhaven Bay on its significance to the cetaceans, which inhabit or visit it seasonally.

9.4 There is little evidence from this document of significant baseline research having been done or proposed to be done prior to the laying of a gas pipeline in Broadhaven Bay, a candidate Special Area of Conservation.

9.5 Cetaceans are as dependent on sound in the sea to “see” the underwater environment as humans are on light. They find each other using sound, they explore their environment using sound, and they find food both by listening to the other sounds in the sea and by emitting sounds, as humans would use a torch in to see the dark.

9.6 On the project where hydrophones used by US scientists to locate whales in the offshore waters of Britain and Ireland, one scientist reported that, “when seismic surveys are operating we cannot hear anything, the noise of the seismic survey masks all other sounds in the sea.”

The sea is full of sounds. Cetaceans are dependent on sound in the sea for their survival. The sea off Galway, Mayo, and Donegal has been ensonified (flooded) with

additional human generated noise (seismic surveys) each summer since the oil companies took an interest in searching for oil and gas reserves under the seabed.

A review by scientists of the effects of Seismic Surveys on Marine Mammals (Gordon, J., Gillespie, D., Potter J., Frantzis, A., Simmonds, M. and Swift, R.) states, “the intense sounds produced during seismic surveys may potentially have physical/physiological and behavioural effects on marine mammals. In addition, there may be long-term consequences due to chronic exposure and sound could affect marine mammals by changing the accessibility of their prey species. No studies have attempted to measure this directly but there are indications that, for sensitive species at least, this may occur at short to moderate ranges. Behavioural responses including: fright, avoidance and changes in behaviour and vocal behaviour, have been observed in baleen whales, odontocetes (toothed whales) and pinnepeds (seals); in some cases at ranges of tens or hundreds of kilometers. The biological significance of these known or predicted effects has not been measured. However, biologically plausible scenarios can be constructed which indicate that in cases, where feeding, migration and social behaviour are affected, the populations could also be reduced. Areas, such as the Atlantic Margin, in which many seismic surveys may be occurring at the same time, may present particular problems for marine mammals.”

Pilot whales have been recorded whistling 40 miles west of the Mullet peninsula, along the landside of the continental shelf in the early morning, probably foraging for their food-squid.

The new sounds generated by human activities such as oil and gas exploration will impact on these and all other cetaceans that use this habitat.

The immediate area of the several wellheads covers an area 25miles by 10 miles on the shelf slope.

9.7 The movements of several species, possibly including endangered species of whales will be affected. It may never be known to what extent because no pre-impact baseline research work on the acoustic environment and the creatures dependent on it has been made accessible or specifically carried out despite the commitments in law made by the Irish government to protect cetaceans and their habitat from disturbance.

9.8 It is regrettable and unacceptable that the data and mitigation measures in this EIS fall far short of those necessary to ensure the protection of marine ecosystems and the integrity of the bio-soundscape in the sea off County Mayo and Ireland. The area has already been disrupted by acoustic pollution over several years and this will continue and increase by the construction of wellheads and a gas pipeline on the seabed. The underwater acoustic impacts have not been adequately addressed in the EIS.

Given the historical importance of the shelf edge off Mayo to whales, cold-water corals and fisheries, its unique fauna qualifies for part of it to be considered as a potential Marine Protected Area in Ireland.

LEGISLATION; THE GOVERNMENT COMMITMENT TO CONSERVATION OF CETACEANS

In 1991 the Irish government declared Irish waters out to the 200-mile limit a Whale and Dolphin Sanctuary.

The Irish government is obliged to implement national laws, European Community environmental law and international conventions to protect cetaceans in the EU exclusive fishery zone and Irish waters.

The Whale Fisheries Act 1937 prevents the hunting of baleen whales within the exclusive fishery limits (200 miles) of the State. An amendment in 1982 extended the Act to protect all cetacean species, including dolphins and porpoises in this area.

The Wildlife Act 1976 states, “in regard to any protected wild animal it is an offence to: willfully interfere with or destroy its breeding place.” (out to the twelve nautical mile limit on the sea.)

The Wildlife Amendment Act (2000).

The Habitats Directive (92/43/EEC) The EU Habitats Directive obliges the government to introduce a regime of strict protection for whales and dolphins in Ireland's marine territory. The Minister for Arts, Culture, Gaeltacht and the Islands is

obliged to prohibit deliberate disturbance during breeding and migration and prohibit the deliberate destruction of their breeding sites and resting places.

All Irish cetacean species are listed in Annex IV (i.e. species of Community interest in need of strict protection). The harbour porpoise and bottlenose dolphin are listed in Annex II (i.e. species of Community interest whose conservation requires the designation of Special Areas of Conservation). The EU have recently clarified that the Habitat and Birds Directive applies to the EEZ, 200 miles from the coast, where member states have exercised their sovereign rights in this area, e.g. for oil and gas exploration

OSPAR CONVENTION 1992 Ireland have recently ratified the OSPAR Convention which contracts member states “to take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected”. It also states “the precautionary principle shall apply, by virtue of which preventive measures are to be taken when there are reasonable grounds for concern that substances discharged into the marine environment may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship between the inputs and the effects. The polluter pays principle, by virtue of which the costs of pollution prevention (including noise in the sea), control and reduction measures are to be borne by the polluter.

Ireland as a signatory to the Ospar Convention is obliged by Article 2, which states;

In fulfilling their obligation under the Convention to take, individually and jointly, the necessary measure to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected, as well as their obligation under the Convention on biological diversity of 5 June 1992 to develop strategies, plans or programmes for the conservation and sustainable use of biological diversity, Contracting Parties shall:

- (a) undertake the necessary measures to protect and conserve the ecosystems and the biological diversity of the maritime area, and to restore, where practicable, marine areas which have been adversely affected; and
- (b) co-operate in adopting programmes and measures for the purpose for the control of activities identified by the application of the criteria in Appendix 3 (b-actual and potential adverse effects of the human activity on specific species, communities and habitats).

Ireland is also signatory to the Bonn and Bern international conventions

The Convention on the Conservation of Migratory species of Wild Animals (The Bonn Convention) enables countries to take action to preserve and manage endangered migratory species within their borders. It was initiated from the realization that failure to protect migratory species can be severely damage efforts to maintain or restore its population.

The Convention of the Conservation of European Wildlife and Natural Habitats (The Bern Convention) aims to conserve wild flora and fauna and their natural habitats. It also aims to promote co-operation between countries in their conservation efforts. Both conventions cover the following species occurring in Irish waters: Blue whale, Humpback whale, Northern right whale, Harbour porpoise, Bottlenose dolphin, White-beak dolphin, Atlantic white-sided dolphin, Rissos dolphin and Long finned pilot whale. Additionally the Bonn convention includes the Beluga and the Berne convention includes Common dolphin, striped dolphin, killer whale, False Killer whale, Northern Bottlenose whale, True's beaked whale, Sowerby's beaked whale and Cuviers beaked whale.

NOTE

The IWDG acknowledges the fact that more money has been spent on cetacean research as a result of the exploration interest of oil companies and this is welcomed by the IWDG – especially when this research is put in the public domain and helps to increase scientific knowledge and awareness of cetaceans in Irish waters.

It is also noted that this money is tax deductible and can be written off as an exploration expense.

DEVELOPMENT COST ALLOWANCE-the allowance for field development outlays (CAPEX) is 100% in the first year of commercial production with unlimited carry forward for unused allowances.

OPERATING EXPENSES-operating expenses are 100% deductible.

EXPLORATION COST ALLOWANCE-exploration costs can be written off immediately (100% write off in Year 1 or as early as possible thereafter). This write off rule relates to all exploration expenses, including those exploration costs that are not field relevant, provided they have been incurred in the 25 year period immediately prior to commencement of field production.

ABANDONMENT COST ALLOWANCE-allowances and loss relief, with respect to abandonment expenditures, are available.

Given any costs incurred by the three EEI partners, Enterprise Oil, Statoil and Marathon can be written off against tax, surely it is in everyone's interest that the baseline work necessary to minimize the environmental impact on cetaceans is completed in advance, on time and put in the public domain prior to development of the Corrib Field.

It would add immeasurably to Ireland's commitment to the conservation of whales and dolphins in Irish and EU waters if its National Heritage Service-Duchas employed a cetacean marine biologist and support staff for the conservation management of Ireland's territorial waters, exclusive fishery zone and continental shelf area for the benefit of its citizens and future generations.

On behalf of the IWDG, S.Fennelly, dated 20/12/2001.

ENCLOSURES

1. Letter from Chris Clark, Senior Scientist, Bioacoustic Research Program, dated 1/6/1998; "we have had detections in the shelf areas where your surveys took place"

To Shay Fennelly Co-ordinator, IWDG Mayo Whale and Dolphin Survey 1993.

2. “Locations of Blue whales to within a few kilometers” published on a public NOAA website, 22/6/2000. <http://www.pmel.noaa.gov/vents/whales/whales.html>

3. Map from 1993 IWDG Whale and Dolphin Survey showing cetacean sightings with location of Corrib Field blocks 18/20 and 18/25 marked.

4. A review by scientists of The Effects of Seismic Surveys on Marine Mammals by Gordon, J., Gillespie, D., Potter J., Frantzis, A., Simmonds, M. and Swift, R. 2000.

2.

SUBMISSION 21/2/2002 ORAL HEARING –AN BORD PLEANALA GAS TERMINAL - SHAY FENNELLY

The Corrib Field lies 70km west of the Mayo coast. The Corrib Field lies 3000 metres below the seabed and 65 kilometres west of the Mullet peninsula in County Mayo. Enterprise Energy Ireland propose to put in place eight well heads on the seabed joined by a pipeline which will carry the gas to a mainland landfall at Dooncarton and 7km inland to a gas terminal at Bellanaboy Bridge.

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The fact that two whaling stations caught over 800 whales off the Mayo coastline 94 years ago identifies the significance of the habitat off this coast to whales. Based on the

whale catch figures it was the most important area off Irelands coast for whales.

The EIS acknowledges seismic surveys elicit avoidance responses from whales (see APP 2.1-12). Disturbance has already occurred from seismic surveys and exploration drilling. The absence of any pre impact baseline survey prior to these activities makes it impossible to assess the effects on the whales and dolphins in the area.

Assertions that, it is unlikely that cetacean species would have been physically damaged

by EEI seismic operations (Impact on Cetaceans App2.1-12)... and that seismic surveys

during June/July 1997 August 1997 are unlikely to have had a significant impact on the

cetaceans in the area are, undocumented.

No scientific assessment of the impact of extensive seismic surveys has been carried out

in Irish waters regardless of international scientific opinion that seismic surveys affect cetaceans, fish, and plankton.

(Page 7-29.) No large whales in the inshore areas through which pipeline is routed.

Was it surveyed? If so where is the data?

(Page 7-29.) The EIS admits the current data is limited, but a conclusion is made on the

basis of it that there is no evidence that Broadhaven Bay is of particular importance to cetaceans.

No significant research has been done or will be done prior to the laying of a gas pipeline

in Broadhaven Bay, a candidate Special Area of Conservation.

The Habitats Directive (92/43/EEC) The EU Habitats Directive obliges the government

to introduce a regime of strict protection for whales and dolphins in Ireland's marine

territory. The Minister for Arts, Culture, Gaeltacht and the Islands is obliged to prohibit

deliberate disturbance during breeding and migration and prohibit the deliberate destruction of their breeding sites and resting places.

Addendum 10/05/2006

Following a public complaint to the European Commission 22/08/2001 about the non implementation of the Habitats Directive with regard to priority cetacean species in Broadhaven bay, a listed marine SAC in County Mayo, Ireland. Shell commissioned UCC in 2002 to undertake a 300,000 euro baseline cetacean survey in Broadhaven Bay.

3.

Letter to EU Environment Commissioner 2002 regarding the Irish Governments neglect of marine conservation of cetaceans in Ireland

11/2/2002

Ms.Margot Wallström
Commissioner for the Environment
B-1049 Brussels
Belgium

Dear Ms. Wallström,

The Irish Whale and Dolphin Group was established in 1990 and is dedicated to the conservation and better understanding of cetaceans (whales, dolphins and porpoises) in Irish waters through study, education and interpretation.

In 1991, following an IWDG proposal, the Irish Government declared Irish waters out to the 200 mile limit, a whale and dolphin sanctuary - the first in Europe. Unfortunately eleven years later the government has yet to match this declaration with a conservation management plan for the conservation and protection of Ireland's and the EU's cetaceans.

Following our attendance at the joint NGO meeting in Dublin we would like to bring the following points to your attention and ask for your help in obtaining answers to these questions.

8 The Conservation of Cetaceans in Ireland's 200 miles Exclusive Fishery Zone and EU territorial waters.

To conserve whales and dolphins in Ireland's exclusive fishery zone, we need to know

- (c) Which species are present?
- (d) What is their distribution?
- (e) What is the population size for each species?

- (f) Which habitats are of importance to them (in terms of feeding, breeding etc.)?
- (g) What threats to their survival are present within the sanctuary?

Baseline research is necessary to answer these questions. However, as of yet there is little sign of the Irish government showing any effort to commission such scientific research on cetaceans or to develop a conservation strategy.

When will the government apply the Habitats Directive to the EEZ, as it is obliged to do under EU law, commission basic scientific research on cetaceans and develop a management system for marine waters under Irish and EU jurisdiction?

9 The Inability or Unwillingness of the Irish Government to Resource the Work which needs to be commissioned.

The biodiversity of marine mammals in Irish waters compares very favourably with terrestrial mammals. Of the thirty-one species of terrestrial mammals recorded in Ireland, eight (25%) are thought to be introduced, leaving twenty-two native species. This compares to twenty-seven native species of marine mammal (24 cetaceans and 3 pinnipeds).

Twenty-three species of cetaceans have been recorded in Irish waters, eleven species are frequently observed, including occasionally the great whales - Blue, Fin, Sei, Humpback and Sperm whales. Many of these species are facing threats from human activities like oil and gas exploration, seismic surveys, industrial pollution and commercial fishing. Data is needed to assess these and other possible impacts on cetaceans.

The state agency tasked with the conservation of Ireland's flora and fauna; (Dúchas - the Heritage Service, has no marine biologist and no marine wildlife expertise. Without proper staff it cannot fulfill its legal responsibilities.

The Irish Government is negligent in not ensuring that Dúchas is properly staffed and funded. Because of this negligence, Dúchas is unable to fulfill its statutory obligations (both nationally and internationally) including the EU Habitats Directive. Areas of scientific and conservation importance remain unprotected and neglected. It is regrettable that Dúchas largely ignores marine conservation. (For example, none of Dúchas wildlife rangers are permitted to go to sea due to health and safety considerations.) Being the body responsible for marine mammal protection in Ireland they have yet to establish a marine conservation unit and appoint any staff to work in this area.

By funding the energy and the fishing industry, the EU is subsidising activities, which may be harming Ireland's marine heritage. The Irish government appears reluctant to protect our marine heritage and has no marine environmental protocols in place to ensure Environmental Impact Assessments are carried out **before** such activities are licensed. The state has a national and statutory responsibility to do this but the relevant departments; Dúchas – the Heritage Service and the Department of Marine and Natural Resources, have currently failed to seriously address and comment on industrial developments projects which will clearly impact on cetaceans, for example, oil and gas exploration, and certain types of commercial fishing.

The Minister for the Marine has the dual role of developing and protecting the marine environment. The lack of a marine conservation management plan has resulted in the neglect of the protection role. Dúchas has no national marine conservation policy, no qualified marine expertise and no resources in this important area to implement the marine requirements of the Habitats Directive.

Being an island state we find it curious that Dúchas has neglected to develop any competence in marine wildlife conservation.

We should be obliged if you would ask the relevant Ministers why this is so and why has the Irish Government allowed this situation to persist year after year?

The EU funds nature conservation in Ireland. Yet the government refuses to invest money on increasing staff numbers in Dúchas and it has no marine conservation policy. We understand, as EU citizens, that the EU has a responsibility to its citizens to see that EU funds are working to fulfil the implementation of EU Directives and to resource conservation strategies in member states. Clearly Dúchas **is not** and **cannot** fulfill its role under the current circumstances.

The funds which could have been used to do this work have been handed back each year to the Irish Exchequer by Dúchas. Why does the EU give funds to the Irish government for nature conservation in Ireland when the government will not spend the necessary money on what is needed to be done?

We should be obliged if you would ask the government and relevant Ministers when they are going to commission a marine conservation management plan for cetaceans and implement the law in Irish and EU waters, in view of the vast amounts of EU funds already subsidising the fishing industry, energy infrastructural development and offshore petroleum exploration?

Priorities for research and action that should be considered if Ireland is to implement a cetacean conservation management plan:

- 2 More fisheries need to be monitored for cetacean bycatch to determine catch rates, especially large pelagic trawlers. Bycatch monitoring could be integrated into work of Marine Institute staff currently reporting discards,
- 3 Methods of mitigating against bycatch in some bottom-set gill net fisheries need to be explored further including pingers, no-take zones and closed seasons as well as gear modifications,
- 4 Abundance estimates of cetaceans in the Irish Sea and off the western seaboard need to be carried out,
- 5 Extensive, long-term monitoring schemes involving strandings and sightings need to be expanded and developed,
- 6 More SAC for bottlenose dolphin and harbour porpoise need to be identified, designated and managed,
- 7 An EIS on the impact of seismic surveys on cetaceans needs to be carried out,
- 8 Continued research on the health status and biological parameters of cetaceans from strandings should be supported,
- 9 Implement legislative commitments already signed up to in the EIA Directive and OSPAR Convention
- 10 The EU could monitor and identify indices that show that the Habitats Directive is applied in EU and Irish waters out to the 200 mile limit as an indicator for sustainable development.

In addition to actions within our own state, we feel that action should be taken to form and integrated whale and dolphin sanctuary covering the waters of all EU states who share a concern for the protection of cetacean species. Already groups in the UK and France have promoted such a concept. Would you be willing to facilitate and promote such an idea in your role as EU Environment Commissioner? We would appreciate your assistance in encouraging the government to take practical measures to protect Ireland's and the European Union's marine wildlife heritage.

With kind regards,
Yours sincerely

Padraig Whooley

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4.

SEISMIC TESTING AND THE IMPACTS OF HIGH INTENSITY SOUND ON WHALES

Lindy Weilgart
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Why whales are vulnerable to noise: • Depend on sound as we do on sight, • Use sound to:

- Communicate with calves
- Communicate with group members
- Mate
- Find prey
- Detect predators
- Detect hazards like beaches, fishing nets, etc.
- Navigate
- Hunt using stealth, listening for their prey (acute hearing)

At least 1/3 of all Cuvier's mass strandings associated with naval maneuvers

- "Miner's canary" for high-intensity sound impacts

From: Hildebrand (2003), citing J. Mead, pers. comm.

VIDAL MARTÍN

- Bahamas 2000
- Canary Is. 2002

Cuvier's and other beaked whale species suffered hemorrhaging in:

- Brain
- Inner ear
- Lungs
- Eyes
- Consistent with

injury from intense sound

Evans and England 2001;

Fernandez et al. 2003;
Jepson et al. 2003

Other known impacts of seismic surveys

Gray whales

- Shifts in behaviour >30 km away
- Faster, straighter swimming over larger areas (disturbance to feeding?)
- More rapid breathing during seismic
- Displacement, closer to shore

Würsig et al. 1999

Other known impacts of seismic surveys

Bowhead whales

(related to North Pacific right whale)

- Previous research: active avoidance at 7-8 km
- Newer research: active avoidance at 20-30 km (diff. in tolerated loudness of 10,000x), returning 24 hrs. later
- More tolerant feeding in summer than migrating in fall
- Changes in dive cycles, breathing rates, up to 73 km away

Richardson et al. 1995; Richardson 2003

Other known impacts of seismic surveys

Humpback whales

- Avoidance at >4 km
- Resting females more sensitive, stayed 7-12 km away
- Males sometimes attracted

McCauley et al. 2000

Other known impacts of seismic surveys

Blue whales

- Avoidance at 3-20 km
- Stopped vocalizing for 1 hr. at 10 km distance
- Feeding <10-20 km away

McDonald et al. 1995; P. Gill, pers. comm.

Other known impacts of seismic surveys

Sperm whales

- Stopped vocalizing for 36 hrs. at 370 km distance
- Apparently tolerant in Gulf of Mexico and off Norway

Bowles et al. 1994; Madsen 2002;
Jaquet, pers. comm.

Conclusion:
Disturbance clearly demonstrated but
situations where seismic sounds are
apparently tolerated

5.

Military Sonar May Give Whales the Bends, Study Says

John Roach
for National Geographic News
October 8, 2003

Undersea noise from naval exercises appears to give beaked whales the bends, an ailment most commonly associated with scuba divers who rise to the ocean surface too quickly, according to a new study. The Canary Island strandings occurred four hours after Spanish-led, international military exercises commenced there. Mid-frequency active sonar was deployed as part of training to secure the Strait of Gibraltar, a militarily strategic location.

Environmentalists say incidences of marine mammal strandings have sharply increased since this mid-frequency sonar technology was deployed. Environmentalists are now actively opposing testing of a new technology, called low-frequency sonar, which they say would significantly expand the geographic range the sound travels.

The finding comes from autopsies performed on beaked whales that stranded themselves on beaches in the Canary Islands four hours after military sonar activities commenced there September 24, 2002. The research is reported in the October 9 issue of *Nature*. Scientists for years have suspected a link between sonar activities and mass strandings of marine mammals—similar events have occurred recently in the Bahamas and Greece—but they are uncertain as to why sonar causes the animals to strand themselves.

The new research is based on autopsies performed by scientists with the Institute for Animal Health at the University of Las Palmas de Gran Canaria in Spain shortly after the beaked whales stranded themselves on the beaches of Fuerteventura and Lanzarote.

The researchers cut into and examined eight Cuvier's beaked whales (*Ziphius cavirostris*), a Blainville's beaked whale (*Mesoplodon densirostris*), and a Gervais' beaked whale (*Mesoplodon europaeus*). They found gas bubbles in blood vessels and hemorrhaged vital organs.

"We think the animals arrived at the coast after the beginning of the exercises in an injured state due to a disseminated microvascular hemorrhage in vital organs, associated with a systemic embolism," said Antonio Fernández, one of the Spanish researchers. "After beaching, their situation was worse due to the well-known stress stranding syndrome that did more severity to the lesions, resulting in cardiovascular collapse and death."

Roger Gentry, a scientist with the National Marine Fisheries Service in Silver Spring, Maryland, who studies marine mammal strandings, said the connection between the beaked whale strandings and the military sonar exercises is clear, but he is not certain the sonar causes an ailment similar to decompression sickness, as reported in *Nature*.

"None of the authors is an expert on decompression sickness and none of the results have been seen by anyone who is an expert on decompression sickness," he said. The fisheries service is trying to set up a workshop before the end of year where the authors of the *Nature* paper can present their findings to experts on decompression sickness. Similar research was presented at a workshop organized by the fisheries service in 2002 and it remains a valid hypothesis, said Gentry.

Sonar and Whales

Sonar technology, such as that used during the Cold War, was passive: essentially big microphones that listened for the distinctive sounds emitted by large submarines.

The U.S. Navy and other militaries around the world have since deployed mid-frequency active sonar designed to find a new generation of smaller, stealthy submarines by sending out sound waves and listening for the reflections off objects, thus giving away their location.

Joel Reynolds, a senior attorney and director of the marine mammals program for the Natural Resources Defense Council in Los Angeles, California, says the new research in *Nature* "is another reason why it is important to regulate the proliferation of active sonar systems around the world."

This August a U.S. District Court judge in California ordered the U.S. Navy to negotiate with environmental groups on when, where, and how it tests the low-frequency sonar.

Gentry with the National Marine Fisheries Service said that the low-frequency sonar is quite different than mid-frequency—operating at 100 to 300 hertz instead of 2,000 to 10,000 hertz—and there is no evidence that low-frequency sonar has caused any strandings.

"The problem we know about is mid-frequency," he said. "There is no firm basis for extrapolating from one group to another."

Mitigating Impacts

Paul Jepson, a wildlife epidemiologist at the Zoological Society of London, who is the lead author of the *Nature* study, said the findings highlight a need for naval and marine mammal scientists to collaborate in order to advance the understanding and mitigation of the impact of active-sonar equipment on cetaceans, particularly beaked whales.

"In order to mitigate the impact of sonar on cetaceans, we need to know where these species are and when they are there," said Jepson.

Gentry said that the fisheries service and the U.S. Navy recognize that there is a cause and effect relationship between the mid-frequency sonar and beaked whale strandings and the agencies are changing the way they use mid-frequency sonar to mitigate the impacts on beaked whales.

"In general, we are very well aware of these strandings and the association with military sonar," he said. "We know we have to be cautious in setting guidelines."

While the fisheries service is not clear why the sonar causes the whales to strand themselves, Jepson and colleagues write in *Nature* that the sonar likely either causes a behavioral change in the whales such as rising too rapidly, or there is a physical effect of the sonar on bubble precursors in nitrogen-saturated tissues.

This physical effect of sonar on whales was proposed by Dorian Houser of the Navy Marine Mammal Program and colleagues in San Diego, California, in 2001. Houser and colleagues devised a mathematical model that shows low-frequency sound waves can rapidly compress and then expand microscopic bubbles of gas in the tissue. Each sound wave causes the bubble to absorb more and more of the gas dissolved in the bloodstream, eventually making the bubbles big enough to rupture tissues.

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6.

Backgrounder

Seismic Surveys at Sea: The contributions of airguns to ocean noise

Contents:

Scope of the Industrial Airgun Presence
Primer on Seismic Surveys and Airguns
Recent Research on the Effects of Airgun Noise
Reports on Ocean Noise

The Story in a Nutshell:

In the wake of recent whale beachings, ocean noise is receiving increasing scrutiny from government agencies, the courts, and academic researchers. While Navy sonars have been the focal point of public concern and legal actions, research released in 2004 points to noise from airguns used in seismic surveys carried out by the oil and gas industry as a key and largely untracked contributor to global ocean noise. In the US, the passage of a new energy bill in the summer of 2005 has increased attention on airguns, as the bill calls for a comprehensive inventory to be made of oil and gas reserves on the Outer Continental Shelf; the Minerals Management Service plans to review existing data and research, then, if and when funding is allocated, to conduct new surveys as needed to flesh out geologic knowledge in areas of high reservoir potential.

Airguns are as loud as the Navy sonars, but they are much more common and ongoing, typically blasting every 10-20 seconds for days or weeks at a time. There are about a hundred commercial seismic survey vessels worldwide, and their activity is increasing the overall background noise in the sea to levels that are likely making long-range whale communication difficult. Even thousands of kilometers from active surveys, field researchers have found airgun noise at times to be the dominant feature in the soundscape. In 2004, the International Whaling Commission called for public notice of industrial surveys and independent monitoring of their biological impacts.

Beachings of whales and dolphins is not as primary an issue as with sonars; only two incidents of coincidental strandings have occurred in association with survey activity. But repeated behavioral disruption, and long-range masking of communication, may be issues. There is a good body of evidence that whales

avoid airguns, with their swimming patterns changed at ranges of 5-30km. Beyond marine mammals, a 1996 study in Norway showed that airguns lowered fish catch rates over a 2,000 square mile area, a 2004 study provided the first suggestions that airguns can cause long-term injuries in snow crabs, and surveys in 2001 and 2003 were implicated surveys in the beachings of squid that died from unexplained internal injuries. While seismic surveys have been taking place for decades, changes in industry practices (including exploration on the continental slopes where sound may bounce into long-range sound channels, and increasing use of 4D (repeat) surveys to monitor reservoir depletion during the life of active reservoirs) may be responsible for the recent burst of reports from biologists concerned about their effects. Surveys are especially common in the North Sea, off the African and South American coasts, the Gulf of Mexico, the South Pacific, and the Indian Ocean.

Scope of the Industrial Airgun Presence:

How many commercial survey vessels are out there?

Estimates given by biologists and geologists range from 50-100 ships worldwide, with 2-20 active on any given day.

The most concrete data I've found:

- 105 seismic survey ships counted in the trade journal OffShore's most recent (2003) survey, not counting the biggest company, WesternGeco (at least 11)
- Over 90 ships in operational condition, 15-20 active on any given day (Tolstoy R/V Ewing calibration paper, 2004)
- Each year there are about 20 MMS-permitted 3-D seismic surveys in the U.S. Gulf of Mexico. (US Minerals Management Service, Programmatic Environmental Impact Statement for Gulf of Mexico Geological and Geophysical Activities, 2004)
- As of early 2004, the industry's current ships were under-utilized. The demand for seismic data has fallen in recent years, since many regions have been well mapped in the past, and consolidation in the oil industry has reduced the number of companies that need additional proprietary data. Countering these trends to some degree are demand for new, higher-resolution surveys, expansion of exploration activity into some previously little-developed areas (Indonesia, Indian Ocean, West Africa) and the increasing practice of doing repeat surveys during the life of a reservoir, to monitor fluid movement in order to maximize the fuel that can be extracted. By early 2005, some industry reports claim that survey vessels are booked to near capacity.

According to the chairman of Veritas, one of the leading seismic exploration companies:

"After many years of conservative or declining exploration budgets, we have clear evidence that our customers, the Exploration and Production (E&P) Companies, are significantly increasing their exploration efforts. Generally, this is true across the board – Major Resource Holders, large and small Independents, International Oil Companies and even the Super Majors – are all stepping up their search for new prospects. . . . I believe the main factor influencing the increase is the ongoing challenge and concern around reserves replacement."

—from the Veritas Seismic Observer (an online periodic journal), April 2005

Primer on Seismic Surveys and Airguns

What are Airguns? Seismic surveys utilize arrays of airguns to produce powerful sound waves; sudden releases of pressurized air bubbles create the sound source, with up to 20 guns fired in synchrony, while “streamers” of hydrophones listen for echoes. Using sophisticated acoustic processing, these echoes can provide information about geological structures up to 40km below the sea floor. Seismic surveys are used by academic geologists to study plate tectonics and sedimentation patterns that hold clues to historic climate change patterns, and by the oil and gas industry in its search for new hydrocarbon deposits and the monitoring of reservoirs as they are emptied. The “source level” of most airgun arrays is 230-240dB (Note: there are many technical elements that must be understood when bandying about decibel figures in the water; getting clear on this is essential to cogent writing on the topic; see link at end of paper.)

Human Noise Sources in the Sea: Over the past several years, public and legal attention regarding ocean noise has focused on military sonar systems such as the Low Frequency Active Sonar (successfully challenged in the US and now used only in limited training ranges; similar systems are under development by at least ten countries, including UK, Spain, Singapore, and Saudi Arabia) and the Mid Frequency Active Sonar (widely deployed by several countries and NATO, and implicated in several strandings of beaked whales in which evidence of acoustic trauma were present). In the past year, two much more common sources of human noise have received increased scrutiny. Shipping is the most omnipresent source of anthropogenic noise in the sea, though not nearly as loud as sonar or airguns; overall, shipping is blamed for a 10-20dB increase in the background noise in the sea throughout the world since 1950 (which translates to a 100x to 1000x increase in the intensity of background noise). Meanwhile, seismic surveys utilizing airguns create noise nearly as loud as the military sonars, but continuing every 10-15 seconds for days or weeks at a time.

A handful of seismic survey ships worldwide are contracted by academic institutions for their studies. Academic surveys use anywhere from 1 to 20 airguns in their arrays; it is quite common for these surveys to use 3-12 guns. The standard “safety radius” is 500-1000m, though it can be less on small-array projects, or more (up to 3km) in certain shallow-water situations; operations stop when whales are in or approaching this distance from the ship.

Meanwhile, there are somewhere in the range of a 50-100 industrial ships equipped with airguns, with 20-30 active at most times, and one or more surveys underway worldwide on most days. Industrial surveys are far more apt to use full-power 20-gun arrays (academic surveys typically make more of an effort to use smaller arrays when possible); however, the standard safety radius is just 500m. Industrial seismic surveys have been taking place worldwide since the 1970s; activity peaked in the late 1980s to mid 1990’s, though a new generation of higher resolution technologies and a trend toward ongoing seismic monitoring of active reservoirs is fueling an increasingly bullish attitude in the industry.

In recent years, industrial exploration has extended farther out to sea, onto the continental slopes, where reflections from the slope may tend to project sound out towards deep water and the SOFAR channel (a layer of the ocean that traps low-frequency sound and transmits it over long distances), adding to global noise pollution.

Also, it is becoming much more common to conduct “4D” surveys, which are repeat surveys over producing oil and gas fields, designed to monitor reservoir depletion and fluid movement, in order to better site wells and maximize the utilization of each reservoir. The North Sea has been the site of many 4D

surveys, and the industry considers the Gulf of Mexico fields now “mature” enough to benefit from the same.

Impacts on nearby ocean life. A well-established body of research indicates that marine mammals tend to avoid active seismic survey vessels, often exhibiting avoidance behavior at ranges of 5-30km; however, it is not uncommon for whales or dolphins to approach closer to operating airguns, whether out of curiosity or because of a biological need to be where they are. In 2002, two beaked whales (the family whales that has proven most susceptible to sonar impacts) were found dead along a shoreline near where an academic survey was underway; they were too decomposed to determine a cause of death, but the incident became the first case of a survey being stopped by the courts due to animal safety concerns. Wild fish stocks similarly avoid active seismic surveys; several studies since 1990 have shown that fish catches decrease by 50% or more in areas of up to 2000 square miles during seismic surveys; there is also evidence that fish egg viability is decreased by long-term exposure to low frequency noise. There has been very little study of the effects of airguns on more sedentary bottom-dwellers, or on plankton and other foundations of the food chain. Recent studies of caged fish and snow crabs have shown that both can sustain physiological damage when airguns pass overhead.

It's important to consider the frequency range of noise sources; the largest biological effects are caused by noise in the same range used by particular animals. Large whales generally use lower frequencies, while dolphins use high frequencies; however, as in terrestrial habitats, different species tend to utilize a wide spectrum of frequencies, so there are few “safe frequency zones” where biological effects might be negligible. Low frequency noise can, in some situations, travel hundreds or thousands of kilometers at levels that are louder than the local background ambient noise, while high frequency sounds attenuate and drop below the ambient background or audible level much closer to their source (on the scale of meters or a few kilometers). Exposure to very high intensity noise can cause direct physiological damage, such as tissue or cell ruptures. This is rare, and generally occurs only when very close, a few meters to a few hundred meters, to a very loud sound source. Temporary threshold shift (TTS) can occur at longer ranges (ie lower received levels of sound); this is basically a temporary loss of hearing, so that a sound must be a bit louder than normal in order to be heard or understood. Permanent threshold shift (PTS), which is in effect permanent partial hearing loss, is also possible after incidental exposure to extremely loud sound or chronic exposure to moderately loud sounds, though this has not well studied, especially in the wild.

Industrial seismic surveys have been in operation worldwide for decades, with relatively few reports of obvious harm to sea life. In general, regulatory agencies and airgun operators proceed under the assumption that fish and whales will move away from airguns, and thus will avoid direct physiological harm. Given the several decades-long history of seismic surveys, and the lack of evidence of massive die-offs, this assumption is likely largely correct (even taking into account that many animals may sink rather than beach if injury leads to death). Only twice (once in the Gallapagos, and once in the Sea of Cortez) have whale beachings occurred coincidentally with seismic surveys; in neither case could the bodies be examined for acoustic trauma. However, the biological effects of displacement/harassment by noise are not well studied, and there is some evidence of long-term hearing damage in cetaceans (based on studies of beached dolphins, both living and dead, about half of which show signs of compromised auditory systems—likely caused by a combination of age, toxins, and chronic exposure to airgun or ship noise, or incidental exposure to louder noises such as explosives).

Underlying much of the concern among both scientists and the public are biological and ethical questions about frequent harassment by human noise; does our need for new oil supplies trump ocean creatures' needs for acoustic space in the seas? Though the effects of behavioral changes caused by animals avoiding sound are impossible to separate from other population-level stressors on sea life (toxins, etc.), given the tenuous recovery of cetaceans, and the global decline in most fish species, calls are increasing to limit additional stressors on these fragile populations of sea life.

Long-range sound transmission: a recent realization. During 2004, bioacousticians have begun reporting that airgun noise from distant surveys along the coast of South America (and perhaps Africa) can be the dominant sounds in some mid-Atlantic study sites, at times making it difficult or impossible to hear the whales or seaquakes they are trying to study. Airgun noise is over 200dB (often 230db) at the source, drops quickly to under 180dB (usually within 50-500m, depending on source level and local conditions), and continues to drop more gradually over the next few kilometers, until leveling off at somewhere near 100dB. At this level, the sound can travel for hundreds or thousands of kilometers; in many or most locations, 100dB is significantly louder than the existing ambient background noise, so the airguns raise the background noise to this level, potentially masking local biological calls and signals. Such effects have been noted at ranges from 1300-3000km from active surveys. These sounds are primarily low frequency, so at long distances, the effects are most pronounced for larger species such as the great whales and some fish that use low-frequency sounds; many fish and the toothed marine mammals such as dolphins, seals, and sperm whales, use higher frequencies in their communication.

At the International Whaling Commission 2004 meetings and at 2004 meetings of the US Marine Mammal Commission's Advisory Committee on Sound, research has been presented that suggests human noise can shrink the area in which whales can communicate with each other by two to four orders of magnitude (that is, when the sea is especially loud, their effective communication area is one hundredth to one ten-thousandth the size that it would be in the absence of human noise).

Regulation and monitoring of seismic surveys. Some countries have begun to take a harder look at airgun noise; during 2004, Mexico has rejected some permits for both academic and industrial surveys, and Brazil is prohibiting surveys near a key marine reserve. Still, worldwide awareness of the long-range acoustic effects of surveys is only beginning to develop.

It is not clear how the international community might regulate noise effects at such long ranges. To date, mitigation measures and operational standards for seismic surveys have been largely aimed at assuring that no marine mammals or sea turtles are directly exposed to airguns at close range.

Most seismic surveys begin with a "ramp up" period, typically 30 minutes, during which the airguns are turned on a few at a time, so that any marine mammals or large fish in the area will be forewarned and have time to move away (smaller fish and turtles may need more time, and of course slow-moving bottom creatures are unlikely to flee). Similarly, as the ships move along their survey lines, their slow approach allows time for animals to move.

In the US, Europe, and Australia, safety zones are routinely established around operating seismic survey vessels, with on-board observers watching for animals entering this zone, which ranges from 150m to 3km, depending on the intensity

of the airgun arrays and local sound propagation properties. Most commonly, the safety radius is 500m to 1km; outside of this zone, sounds are generally considered to be less than 180dB, the threshold where physical damage is considered likely. (Thresholds are 160db for some species; the danger zone is different for each species, and of course, for each type of damage being considered; these have become the de facto standards for avoiding catastrophic tissue damage.)

Since ocean noise by its nature a trans-national problem, initiatives are underway to formally include noise as a "pollutant" under international treaties such as the UN Law of the Sea. Toward this, other regional, national, and state ocean policy agencies have begun to address ocean noise questions, driven by concerns about sonar and shipping, to which seismic surveys are beginning to be added. Examples of this during 2004 include the International Whaling Commission recommendations, the State of California Action Strategy for ocean policy, and resolutions passed in the European Union parliament and ACCOBAMS (a consortium of 16 Mediterranean countries).

What Can be Done?

Responses to the increasing concerns about the effects of seismic surveys range across the entire spectrum of possible actions. At one end of the spectrum is the "business as usual" response, which relies on the long history of airguns with little dramatic evidence of problems. For example, the US Minerals Management Service recently released a draft Programmatic Environmental Impact Statement for survey activity in the Gulf of Mexico, and is content with the current 500m exclusion zones. At the other end of the spectrum are calls for a moratorium on surveys and legal challenges that stopped several surveys in their tracks during 2004.

Modest proactive steps have taken place within some permitting agencies, including the US National Oceanic and Atmospheric Administration (NOAA) and the UK Department of Trade and Industry (DTI), both of which have begun calling for use of "passive acoustic monitoring" (listening for whales, rather than relying solely on visual monitoring, which is known to spot only a small fraction of whales present), and at times enforcing larger exclusion zones (up to 3km in certain situations).

The more dramatic suggestions made by the IWC deserve wider consideration. In addition to calls for public information about industrial surveys (so that agencies can better consider the cumulative impacts of many surveys in one area), the IWC strongly recommended that surveys be accompanied by "continuous" biological effects monitoring, extending before, during, and after all surveys. The costs of such monitoring have severely limited the academic community in its ability to do these comprehensive studies. While requiring industry to fund a wide range of biological effects studies would add to the cost of oil exploration, it should be considered a viable and prudent option at this time. The industry has funded some of the most important studies to date; there remains a pressing need for more comprehensive research. Given that seismic surveys are the most common extreme noise source in the sea, it may be reasonable to ask commercial survey companies to fund the research needed to determine their long-term and long-range effects on sea life.

2004 Research on the Effects of Airgun Noise

Squid Show Signs of Acoustic Trauma - Several beachings of giant squid along the coast of Spain have raised concerns that their deaths may have been caused by exposure

to loud sounds, possibly seismic survey airguns. Unusual numbers of stranded squid appeared during seismic surveys in both 2001 and 2003, according to researcher Angel Guerra. None had signs of superficial damage, but all had internal injuries. Ear damage was present in all specimens, with further organ and tissue damage in some. "No one has ever seen this before in giant squid," says Guerra, who fears there might be many more victims. Local fishermen also reported seeing large numbers of dead fish floating at sea during the surveys. These were the first seismic surveys in the area, but Guerra says the surveyors, led by geologists from the University of Orviedo and affiliated with the Spanish oil company Repsol, plan to continue in 2005. Source: New Scientist, 9/22/04
<http://www.newscientist.com/news/news.jsp?id=ns99996437>

Snow Crabs Show Damage From Airguns - The first controlled study of snow crabs exposed to an active seismic survey has revealed a surprising amount of physiological damage. Crabs, which were caged on the seafloor as airguns passed 40 meters above them, exhibited tissue and organ damage, slightly poorer reproduction, and an increased number of lost legs. Canadian Department of Fisheries and Oceans researchers, who did the study, noted that there was no significant change in mortality or feeding patterns in crabs exposed to airguns, but that hemorrhaging and membrane detachment in the crabs' ovaries was noted, and that the condition intensified between December (when the crabs were exposed to the airguns) and May. Similarly long-lasting and worsening effects were also detected in the hepatopancreas, which functions like a liver in a crab, with abnormal cell structure, swelling and stress detected. While the scientists cautioned that temperature differences or handling in the cages may have been responsible for some of the physical damage observed, and called for further study, environmental groups expressed shock at the results and called for consideration of an immediate moratorium on seismic testing.

Sources: Halifax Herald, 10/2/04

<http://www.herald.ns.ca/stories/2004/10/02/f292.raw.html>

Halifax Herald, 10/7/04 (more on various interpretations)

<http://www.herald.ns.ca/stories/2004/10/07/fBusiness195.raw.html>

Sierra Club Press Release, 10/4/04

<http://www.sierraclub.ca/national/media/item.shtml?x=740>

International Whaling Commission Scientific Committee, 2004 meeting:

Full Report on the Mini-symposium on Anthropogenic Noise:

<http://acousticecology.org/docs/IWC56-noisesymposium.doc>

Section of Scientific Committee Report addressing the Noise Symposium and Recommendations (which was unanimously adopted by the full IWC membership):

<http://acousticecology.org/docs/IWC56-SCReportNoiseSymposium.doc>

Regarding seismic surveys, the SC and IWC endorsed a set of detailed protocols for mitigation and monitoring near seismic surveys, including access to information regarding timing, distribution, and extent of surveys (both planned and historic patterns) in critical habitats or potentially critical habitats, continuous acoustic monitoring of critical habitats before, during, and after seismic surveys, and independent monitoring of critical habitats to evaluate displacement or disruption of important behaviours (further specified to mean "independent and highly experienced shipboard marine observers and a monitoring system and platform that are independent of the seismic source vessel and seismic support vessels"). These (and several other) recommendations were commended to member countries for adoption, and requested to be passed on to representatives of the oil and gas industry and geophysical academic teams and relevant government committees and agencies.

The SC report noted that seismic surveys have been shown to cause displacement of whales from their feeding grounds both off Sakhalin Island, and off the coast of Brazil. The Committee commended Brazil for its work to protect critical marine habitats from noise exposure, and "views with great concern the impacts. . . from exposures to seismic sound impulses, particularly with respect to threatened populations such as the western gray whale."

Sound from seismic survey airguns increased the measured ambient noise levels of a blue and fin whale feeding area in the North Atlantic by two

orders of magnitude (a 100-fold increase). (Christopher Clark, Cornell) This increase, observed throughout a nearly hundred thousand square kilometer study area (200x400 nautical miles), was nearly continuous for days at a time; such long-range effects contrast with typical effects modeling, which focus on areas very near the survey vessels and consider the effects of a single seismic shot lasting only a fraction of a second.

Questions were raised about the effects of such chronic elevated noise exposure on searches for prey, and finding suitable mates. Roger Payne presented additional information on the role of infrasound in maintaining whale "heards." He hypothesized that baleen whale populations might live in acoustic contact throughout an ocean basin where very long-range communication can take place; elevated levels of low frequency noise could very well disrupt such long-range communication, with potentially dramatic effects of reproductive success and thus population vitality. **In certain Northern Hemisphere ocean regions the area in which a fin whale can hear a compatriot has decreased by four order of magnitude (ie, calls can be heard in an area one ten-thousandth as large as previously).** Payne noted that in spite of great efforts to find them, there are no known breeding grounds for open ocean populations of fin whales, suggesting that there may be no need for fin whales to meet *en masse* at particular times and places, if they are able to get together, simply by calling and listening for each other over great distances—they may indeed have no breeding grounds simply because they are not necessary.

Minerals Management Service Programmatic Environmental Assessment on Geological and Geophysical Activities in the Gulf of Mexico – This long-anticipated PEA on seismic surveys and other geologic and geophysical activities by the oil and gas industry sets a standard 500m safety radius, and lays the groundwork for MMS to request routine "incidental harassment authorizations" from NOAA for commercial surveys in the Gulf. See article from Petroleum News:

<http://www.petroleumnews.com/pntruncate/438755804.shtml> Or, See MMS press release: <http://www.gomr.mms.gov/homepg/whatsnew/newsreal/2004/040803.html>

Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean (Nieukirk, Stafford, Mellenger, Dziak, Fox. J. Acoust. Soc. Am., Vol. 115, No. 4, April 2004. P. 1832-1843)

(From Discussion section):

Since this hydrophone array was deployed, the periodic impulses produced by seismic exploration vessels operating around the Atlantic basin were the dominant signal detected.

Concern over the potential effects of anthropogenic noise on marine life has been such that the National Research Council of the (U.S.) National Academy of Science has commissioned three studies on this topic to date (NRC 1994, 2000, 2003). Although seismic airgun arrays are designed to direct the majority of emitted energy downward through the seafloor, their sound emission horizontally is also significant (NRC, 2003). Airgun survey vessels were often located 3000 km or more from our array (Fig. 1), yet airgun pulses were still clearly recorded on each hydrophone. The broadband frequency range and repeated firing of these guns make them a major contributor to the low-frequency sound field in the North Atlantic.

Airgun activity in shallow water has been shown to significantly damage the ears of fish (McCauley *et al.*, 2000) and has been implicated in the stranding of beaked whales (Malakoff 2002; NRC 2003). Its effect on the baleen whales studied here is unknown; possible effects include masking of conspecific sounds, increased stress levels, changing vocalizations, and ear damage (Richardson *et al.*, 1995). Most of the seismic vessels we located

were operating in marine mammal habitat, including that of the critically endangered northern right whale.

Airgun pulses were recorded year-round but were most common from late spring through fall. This pattern is the opposite of the peak occurrences for all baleen whale calls. It is possible that the seasonal patterns seen in baleen whale calls are due to airgun interference: that is, the calls are produced in the summer months but obscured by airguns. However, because calls are detected during some months of frequent airgun occurrence in the fall, because the repetition rate of airguns is such that most whale sounds can be detected between pulses (Fig. 8), and because the data were visually inspected, we don't believe that many calls were missed due to interference (cf. Clark and Charif, 1998).

(From Results section):

Sounds associated with seismic airguns were recorded routinely on all hydrophones, and trends were similar in the two years (Fig. 7). Typically airguns were heard every 10–20 s (Fig. 8). Although airgun sounds tended to dominate recordings during the summer months, loud whale vocalizations could still be detected during intense airgun activity (Fig. 8). Occasionally the array recorded airguns from more than one location, masking cetacean sounds and on four occasions making the spectrogram data impossible to use. The high received level of these impulses on multiple hydrophones made it possible to estimate the locations of the ships conducting the airgun surveys. During the summer months, airguns operated off Nova Scotia, Canada, probably in support of exploration in the Sable Island region (Fig. 1). From spring through fall seismic vessels, presumably commercial, were located working off the coast of western Africa and northeast of Brazil. Seismic vessels operating in other areas of active exploration, such as the North Sea and the Gulf of Mexico, were not observed by this array due to bathymetric blockage.

Reports on Ocean Noise:

SEE ALSO: www.AcousticEcology.org/science.html

Seismic Surveys: What We Don't Know Can Hurt - A research overview by Acoustic Ecology Institute Executive Director Jim Cummings, commissioned by Greenpeace, 2004. <http://acousticecology.org/oceanairgunexecsumm.html>

Impacts of Anthropogenic Sound on Marine Environments - Paper by Michael Stocker, commissioned by Earth Island Institute, with a special focus on the use of sound by fish and mollusks and a brief overview of natural and biological noise in the oceans. <http://www.msa-design.com/FishEars.html>

Oceans of Noise - The UK-based Whale and Dolphin Conservation Society has released a 165 page report, available on its website; its primary focus is on taking action to protect sea life from damaging impacts. <http://www.wdcs.org/dan/publishing.nsf/allweb/64543E9BBF9860D780256D2D00331176>

Ocean Noise and Marine Mammals - From the Ocean Studies Board of the National Research Council, a US-government funded institute, this is an overview of existing research. Its tone is predictably cautious (the press release is titled, accurately enough: Impact of Noise on Marine Mammals Remains Unclear), mentioning concerns but stopping short of raising alarms, though it does make urgent calls for further study. Among its especially useful sections is an overview of natural noise sources in the oceans. <http://www4.nationalacademies.org/news.nsf/isbn/0309085365>

US Marine Mammal Commission Sound Program – Sponsoring a series of plenary sessions and workshops on ocean noise. The page for each past event includes links to papers on the topic of the event (which have ranged from shipping to international law and general noise issues).

<http://www.mmc.gov/sound/>

OGP (International Association of Oil and Gas Producers) Marine Mammal info. A new Joint Industry Project (JIP) was initiated in early 2005. The JIP will take place in two stages: a scoping study followed by a detailed research programme.

<http://www.ogp.org.uk/Issues/MarMams.asp#962>

IAGC (International Association of Geophysical Contractors) Marine Mammals and Sound

http://www.iagc.org/xtrasp/3_3.asp

For more information on ocean acoustics, including important discussions of dB measures in the sea and air, and natural sources of loud underwater sound, see:
<http://www.acousticecology.org/oceanacoustics.html>