Before the Environmental Protection Authority

Application for Marine Consent by Chatham Rock Phosphate Ltd

IN THE
MATTER OF

the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

AND

IN THE
MATTER OF

An application by Chatham Rock Phosphate Ltd for a marine consent application made to mine phosphate nodules from the seabed of the exclusive economic zone on the Chatham Rise.

Supplementary Evidence of Associate Professor Elisabeth Slooten

Otago University

on behalf of

Greenpeace New Zealand, Incorporated

Kiwis Against Seabed Mining, Incorporated and

Deep Sea Conservation Coalition, Incorporated

Dated 20 October 2014
SUPPLEMENTARY STATEMENT OF EVIDENCE OF ASSOCIATE PROFESSOR ELISABETH SLOOTEN

Qualifications and experience

1. My name is Elisabeth Slooten. I am an Associate Professor in the Department of Zoology at the University of Otago in Dunedin, where I have worked since 1990. I have undertaken extensive research on marine mammals in New Zealand waters since 1984, including research on New Zealand dolphins (Hector’s and Maui’s dolphins), bottlenose dolphins, dusky dolphins, sperm whales, humpback whales, right whales and New Zealand sealions.

2. My research includes population surveys to study the abundance and distribution of marine mammals, estimation of survival and reproductive rates, behavioural research, population viability analyses and risk analyses to quantify the impact of fishing, tourism and other human activities on marine mammals. The population survey work includes boat surveys, aerial surveys using planes and helicopters, acoustic surveys using towed hydrophone arrays, directional hydrophones and passive acoustic data loggers.

3. For more information about my qualifications, please see my Evidence of 12 September.

4. I confirm that I have read the ‘Code of Conduct for Expert Witnesses’ as contained in Schedule 4 of the Judicature Act 1908 and the Environment Court Consolidated Practice Note 2011. I agree to comply with these Codes of Conduct. Except where I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express. I understand that my overriding duty is to provide scientific advice to the DMC.
Key points in this evidence

5. Insufficient information has been provided on marine mammals on the Chatham Rise.

6. In order to assess probable impacts on marine mammals, baseline visual and acoustic surveys would need to be carried out.

7. The potential impacts on marine mammals include:

   • Permanent hearing impairment (close to the mining operation)
   • Temporary hearing impairment (within 3 km from the proposed mining operation)
   • Behavioural responses, including marine mammals leaving the area (within about 30 km)
   • Compromised ability to communicate and orient (for those species using echolocation), reduction in their capability to listen passively for prey and natural sounds that may act as navigational aids
   • Distraction, annoyance and stress responses
   • Habitat degradation, including direct damage to benthic communities from mining and indirect impacts caused by the sediment plume
   • Ecological impacts on invertebrates, fish communities and predators, including marine mammals (beyond the mining area, including from pollution such as uranium)
   • Impacts on marine mammals which may come into contact with the plume
   • Marine mammal collisions with vessels and mining equipment
   • Cumulative impacts of the proposed mining operation and existing impacts (including fishing)

8. Only noise impacts were discussed in any detail at the marine mammal expert meeting on 15 October, although Sound Exposure Levels (SEL) were not considered.

9. No empirical data are available on noise generated by the proposed mining operation.

   The noise modeling exercise involved extrapolating noise from a shallow water gravel mining operation. This extrapolation did not include noise caused by movement of phosphorite-bearing
material through the pipe leading to the ship, nor noise from a second pipe returning waste material to the seafloor.

10. An assessment of the potential impacts of noise produced by the proposed mining operation would require acoustic measurements from a mining operation similar to the one proposed.

10.1 If such information is available (e.g. by obtaining acoustic measurements from any similar operation) it is important that this be obtained, in order to reduce uncertainty about the potential impacts.

10.2 If the proposed mining operation is unlike any other marine mining operation in the world, this further increases the level of uncertainty about the potential impacts on marine mammals.

11. There is a high level of uncertainty about noise and other impacts. This is in part due to uncertainties about the technical specifications of the proposed mining operation (e.g. noise from the vessel, noise from pumps in including the dredge pump, the travel of material through pipes for some 450 metres each way leading to and from the seafloor). Other uncertainties relate to a lack of data on the environmental sensitivities. There are a number of potentially serious impacts on marine mammals. A more rigorous environmental impact assessment would be needed to assess the severity of the impacts of this development on marine mammals.

MARINE MAMMALS FOUND IN THE CHATHAM RISE AREA

12. Marine mammal species known to use the Chatham rise area include blue whales, bottlenose dolphins, common dolphins, dusky dolphins, false killer whales, humpback whales, killer whales, minke whales, pilot whales, sei whales, southern right whales, sperm whales and NZ fur seals, plus the species group beaked whales (Torres et al. 2013).

13. The information on marine mammals provided by the applicant is inadequate and suffers from several methodological problems (e.g. Huber et al. 2014). As has been pointed out by (Huber et al. 2014), no marine mammal surveys were carried out on any of CRP’s six research expeditions. Due to this lost opportunity, Torres et al. (2013) were forced to rely on two sets of anecdotal data – one from the Department of Conservation (DOC) and one from Mr Martin Cawthorn.
14. The information provided by CRP on marine mammals essentially consists of a species list. This is obviously inadequate in terms of assessing the effects of the proposed mining operation on marine mammals. It is therefore not possible to assess the significance of the proposed marine consent area as habitat for marine mammals due to lack of information.

15. Where a sighting was made, we can be confident that a marine mammal was present, but not necessarily that the species identification was correct. In a location where no sightings were made this can be for a number of possible reasons, including:

15.1 No ships travelled through this area

15.2 The only ship time in the area was at night or in other conditions where visibility is limited (e.g. fog, rough weather conditions)

15.3 No marine mammal observer was on watch

15.4 Insufficient observers were available to keep a watch during all daylight hours

15.5 An observer was available, but had already been on watch for a lengthy period and was missing sightings

15.6 A well-rested observer was available, but insufficiently trained to spot marine mammals or to be confident of species identification

15.7 Two trained, well rested observers were on watch, together with a recorder (normal survey protocol for marine mammal surveys) but the marine mammal was underwater and therefore not “available” to be sighted when the ship passed through the area

15.8 Two trained, well rested observers and a recorder were on watch and the marine mammal was at the surface, available to be sighted but too far away from the ship to be seen or to be identified correctly.

15.9 Two trained, well rested observers and a recorder were on watch and the marine mammal was at the surface, available to be sighted but was not noticed by the observers because they were looking elsewhere at the time and the surfacing was too brief and cryptic to draw attention (this is commonly true of beaked whales).
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In a normal marine mammal survey these three last factors are empirically estimated, using specific, scientifically robust procedures. It is standard practice to report the proportion of individuals, for each species, that are detected by observers. For the two sources of anecdotal data used by CRP, it is impossible to estimate the proportion of individuals missed. This makes it impossible, with these data sources, to provide data that are useful for predicting impacts on the marine mammals of the Chatham Rise area. Likewise if the proposed mining were approved it would be impossible, with the currently available data, to detect impacts on marine mammals. Finally, it means that the data reported by CRP represent an absolute minimum indication of the range and occurrence of marine mammals in the area.

16. A scientifically robust survey, using a combination of visual and acoustic methods, would need to be carried out in order to assess the potential effects of the proposed mining on marine mammals in the area. This survey should be designed to provide data on marine mammal densities and habitat use in the area. In the absence of such data, it is not possible to adequately assess marine mammal densities and habitat use, and therefore the potential impacts of the proposed project on marine mammals. As explained in the Joint Statement of Experts in the Field of Marine Mammals (hereafter referred to as the “Joint Statement”), a lack of baseline data makes an effective assessment of probable impacts on marine mammals impossible.

17. One of the few conclusions that can be drawn is that some of the species that appear to be relatively common on the Chatham Rise – in particular sperm whales and beaked whales – are known to be particularly sensitive to human-made noise in their environment (e.g. Miller et al. 2009, Thode et al. 2007, Barlow & Gisiner 2006, Cox et al. 2006).

18. The total population size and conservation status of these species is critical in terms of assessing the population level impacts of the mining proposed. If the species or population in question is Endangered, Critically Endangered or already declining due to other human impacts then additional impacts from mining have the potential to make the difference between population decline and recovery.

POTENTIAL IMPACTS

19. The potential impacts of the proposed mining operation include:

19.1 Consequences of noise exposure, include compromised ability of marine mammals to orient (for those species using echolocation) and communicate, reduction in their capability to listen
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passively for prey and natural sounds that may act as navigational aids, distraction, annoyance and stress responses.

19.2 Habitat degradation, including direct damage to benthic communities from mining and indirect impacts caused by the sediment plume

19.3 Marine mammal collisions with vessels and mining equipment

19.4 Consequences of chemical pollution caused by antifouling and oils from the vessels used in the operation as well as from the increased availability of toxins due to the mining activity, such as compromised immune and endocrine systems, and stress responses.

The impacts listed above, singly or in combination, have the potential to impact marine mammals in the mining area, and depending on the extent of the impact (e.g. noise, sediment plume) for a wider area. A quantitative assessment of these potential impacts needs to include consideration of the cumulative effects – of the impacts from the proposed mining in combination with other, existing impacts.

NOISE

20. Insufficient information has been provided on noise. As explained in the joint statement, the noise estimates are based on extrapolation from gravel extraction in shallow water (approx. 25 m). This is clearly not representative of extracting phosphate nodules in 400 m water depth. The pumps for the proposed mining operation on the Chatham Rise are much larger (12 MW vs 2.7 MW), with 12 MW being on the order of the power generated by a large vessel’s main engines (e.g. interisland ferry Arahura). There is a high level of uncertainty about the actual noise characteristics of the proposed mining operation. This uncertainty could be substantially reduced by obtaining more realistic noise measurements.

21. Physiological effects of noise include direct damage to organs and tissues, permanent or temporary hearing threshold shifts (PTS and TTS) and stress (e.g. Finneran et al. 2000, Lucke et al. 2009, Popov et al. 2013, Rolland et al. 2012). Noise can also mask marine mammal vocalisations, interfere with communication and echolocation, cause behavioural impacts such as disruption of activities and exclusion from habitat, cause fear conditioning and distraction from biologically important activities (e.g. McCarthy et al. 2011, Castellote et al. 2012, Iorio and Clark 2010, Parks et al. 2011, Nieukirk
The negative impacts of human-made noise on cetaceans are well known. For example, sperm whales are known to be highly sensitive to noise pollution (Miller et al. 2009, Thode et al. 2007) as they use echolocation for navigation, foraging and communication. Likewise, the communication range for pilot whales was reduced by up to 58% due to small vessel noise from vessels travelling at 5 knots within 50 m in a study by Jensen et al. (2009). Changes in the acoustic behaviour of killer whales have been documented in response to increased anthropogenic noise (e.g. Holt et al. 2011). Beaked whales are known to be especially sensitive to human made noise, with increasing evidence of deaths (including mass strandings) directly or indirectly caused by noise (e.g. Barlow & Gisiner 2006, Cox et al. 2006). Right whale reactions to increased vessel noise include habitat displacement, behavioural changes, increased stress hormone levels and changes in the frequency and intervals of acoustic calls (Hatch et al. 2012, Parks et al. 2011, Rolland et al. 2012, Wright et al. 2013). Impacts on blue whale and humpback whale behaviour and communication patterns in response to noise have also been documented (Iorio & Clark 2010, Melcon et al. 2012).

The joint statement concluded that there is a low risk of permanent physical damage to marine mammals caused by noise from the proposed mining operation. Temporary threshold shifts are more likely, within 3 km and especially within 1.5 km. Impacts on marine mammal behaviour are likely within 30 km, and potentially much further from the mining operation. Stress responses and some masking may continue beyond this distance.

Simple threshold criteria are not useful (Melcon et al. 2012, Risch et al. 2012, Ellison et al. 2012, Castellote et al. 2012, Robertson et al. 2013). For example, the information in Southall et al. (2007) does not provide a simple cut-off distance at which behavioural impacts start to become a problem. For a more recent review of the impacts of noise on marine mammals, see the latest US guidelines (NOAA 2013) and expert comments on those guidelines during consultation. These consider not just of sound pressure (loudness) but also the duration of exposure (SEL, sound exposure level). For example, noise exposure of marine mammals in the general area, for extended periods, may lead to some hearing loss. It is not possible to assess this potential without more information. An assessment of cumulative sound exposure levels would be needed.

Recent research indicates that duration is an important factor, with identical SELs having much greater impacts if delivered over longer time periods. TTS can be caused by either a short period of
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exposure to a very loud noise or a longer exposure to a much lower noise level (NOAA 2013). The simplifying Equal Energy Hypothesis assumes that sounds of equal cumulative SEL produce the same risk for hearing loss. i.e. If the cumulative SEL of two noise sources is similar, a sound from a lower level loudness with a longer exposure duration may have similar risks to a shorter duration exposure to a louder noise. However, it has been shown that this hypothesis does not always hold true due to the inherent complexity of predicting threshold shifts in marine mammals (e.g. Mooney et al. 2009). Exposure over a longer time period can cause TTS at a lower total level of exposure than would be predicted on the basis of the Equal Energy Hypothesis.

26. The proposed mining is likely to be audible to marine mammals over considerable distances. For example, the acoustic modelling carried out for CRP predicts a noise level of 110 dB at 114 km from the proposed mining operation (JASCO report, appendix of Ketten evidence). The potential for physical injury and other impacts depends on the density of marine mammals in the area, which at this stage is very poorly known.

27. Data on actual responses of dolphins or other marine mammals to marine mining of the type proposed are required in order to assess the potential impact on marine mammals, collected using a BACI (Before, After, Control, Impact) design. Data on the responses of (non-threatened) marine mammal species in other areas where this type of marine mining is used would be required in order to assess the likely impacts of the development proposed by CRP. Determining whether marine mammals avoid areas with marine mining would take at least three years of “before” and three years of “after” observations, following a rigorous experimental design. Acoustic data loggers could be used as a research tool. Visual surveys by boat and/or aircraft could also be used. Photographic identification of individual marine mammals would also provide useful information about the movements of individuals and for some species (with relatively high population density) information on population size.

28. Impacts caused by noise need to be considered in combination with other potential impacts from mining (e.g. sedimentation and indirect ecosystem effects) as well as impacts from other human activities (e.g. fishing). For example, it is possible that animals avoiding the mining noise will increase their exposure to other human impacts such as fishing (Forney et al. 2013, Wright et al. 2013).

29. There is increasing concern about the potential impacts of noise on fish (e.g. Slabbekoorn et al. 2010), including physical damage, behavioural responses, disturbance and stress. There is high uncertainty
about the potential impacts of this mining operation on fish and therefore on marine mammal feeding success.

30. There is increasing concern about the potential impacts of noise on invertebrates (e.g. Nedelec et al. 2014; Wale et al., 2013), including physical damage, compromised embryonic development, increased mortality, behavioural responses, distraction and stress. There is high uncertainty about the potential impacts of this mining operation on invertebrates and therefore on the food chain and the wider ecosystem, including marine mammals.

HABITAT

31. The impacts of marine mining on marine mammals have been identified as an important conservation issue in the scientific literature, especially for populations already impacted by other human activities such as fisheries (e.g. Bergman et al. 1991; Nairn et al. 2004). Benthic and fish communities tend to take on the order of decades to recover, with impacts on marine mammals taking on the order of 20-50 years (e.g. Boyd et al. 2005; Bergman et al. 1991). Of course this assumes that the marine mammal populations in the area being mined were at healthy levels before mining began. These impacts have led to mining being prohibited in most Marine Mammal Protected Areas (Hoyt 2011). The potential impacts include marine mammals being displaced from their current habitat, due to direct disturbance (e.g. noise caused by mining, vessel traffic, sediment dumping and unusual levels of turbidity) and/or indirect impacts (in particular ecological effects on dolphin prey). These direct and indirect impacts are likely to increase fragmentation of marine mammal populations and may slow the recovery of a range of species, including humpback whales, right whales and blue whales.

32. As pointed out by Huber et al. (2014) several aspects of the impact assessment, including the information on marine mammal distribution, “rely entirely on review of limited desktop information”. This basically precludes scientifically robust conclusions on the likely environmental impacts of the proposed mining operation. For example, information about the biological communities of large parts of the consent application area has been extrapolated from surveys in other areas using modelling. The conclusions of many of the technical reports include statements that very little local information is available, obviously precluding any reasonable assessment of impacts.

33. Increased sedimentation and physical damage to the benthic environment may impact foraging success for some marine mammals, for example due to decreased sensory capabilities (visual and acoustic) and/or avoidance of the area by marine mammal prey. Even if a species of marine mammal does not feed in the Chatham Rise area, foraging habitat surrounding the Chatham Rise area may be
affected by the sediment plume. Torres et al. (2013) raised particular concern about increased sediment or a disturbed environment along the southern edge of the Chatham Rise and its potential impact on southern right whales. Similar impacts may also affect other marine mammals using the Chatham Rise area. Sediment plumes are likely to impact important prey aggregations for marine mammals, at the same time as decreasing the ability of marine mammals to detect their prey. For more information on potential habitat impacts, see Associate Professor Watling’s evidence.

34. Hard corals such as *G. dumosa* normally live in areas that have very low rates of sedimentation. Even minor levels of sedimentation are predicted to impact this coral. *G. dumosa* forms thickets that provide habitat for other species. Insufficient information has been provided about these communities to assess the number of species which might be displaced when the habitat-forming species are removed, let alone to predict flow-on ecological impact at higher trophic levels for fish and ultimately for predators like marine mammals. For more information on benthic communities see Associate Professor Watling’s evidence. Until more scientific data become available it is impossible to assess the indirect ecological impacts of the proposed mining activity on organisms at higher trophic levels, including marine mammals.

35. Data on the ecological links between infauna (organisms living in the sediment), epifauna (organisms living on the sea floor) and marine mammals in the Chatham Rise area are completely absent, but are essential in order to determine the likely indirect effects of mining on the marine mammals in the area. It is very important to establish how the ecological community living in and on the substrate interacts with the fish fauna in the area. That will help establish the indirect effects of mining on fish and fish predators, including marine mammals and seabirds (e.g. Nairn et al. 2004).

36. One of the potential risks is displacement of marine mammals from the area, either due to the presence of mining equipment and vessels or due to the noise generated by them. For example, this effect has been observed in harbour porpoises in reaction to windfarm noise (e.g. Koschinski et al. 2003; Weilgart 2007). Considering the endangered status of some of these marine mammal species, displacement from an area of habitat could have serious consequences.

**COLLISIONS**

37. Most vessel strikes of marine mammals are unreported (Torres et al. 2013) for a number of reasons, including:
37.1 The crew of the ship did not notice the collision

37.2 The marine mammal was injured, but the injury was not obvious to the ship’s crew (e.g. broken ribs or a cracked skull may not show as obvious, external injuries, but these can cause death, soon after the boat strike or later)

37.3 There was an obviously visible external injury, but this did not look sufficient to kill the animal (immediately or subsequently)

37.4 The animal died immediately, but this was not obvious to the vessel’s crew (e.g. a struck whale that sinks immediately)

37.5 The crew did not know they should report the ship strike, forgot or decided not to report (e.g. there is a legal requirement to report bycatch of marine mammals in fishing gear, but only a very small proportion is ever reported).

38. Reported vessel strikes are relatively rare in New Zealand, compared to many other countries. However, they are increasing, with increasing vessel traffic. It is important to avoid activities like shipping and mining in or through areas with relatively high marine mammal densities.

POLLUTION

39. The sediments of the Chatham Rise contain uranium and other associated radionuclides, at levels considerably above levels in normal, uncontaminated marine sediments (e.g. evidence of Dr Peake, and Joint Statement of Experts in the Field of Radioactivity). Mining, processing and dumping the remaining material will result in significant disturbance, suspension and redistribution of surface sediments and the solubilisation and mobilisation of uranium and other radiological materials. The discharged plume of sediment and process water is expected to contain concentrations of uranium and associated radionuclides considerably higher than naturally occurring background concentrations. This has the potential to change the radiation field of the wider benthic environment, well beyond the area being mined.

40. There is considerable uncertainty about the height of the sediment plume above the seafloor and the toxicity of the material to be mined to the biota of the Chatham Rise. Within the mixing zone, there will be elevated levels of trace elements in the water column including those of uranium, to which
Chatham Rise organisms will be exposed for the period of mixing. These have the potential to bioaccumulate in fish and other organisms at higher trophic levels (e.g. seabirds and marine mammals). No relevant measurements have been provided of the concentration of these elements in fish on the Chatham Rise. Such measurements would need to be made to assess the potential for bioaccumulation (see Professor Peake’s evidence).

41. If bio-uptake occurs, levels would be expected to be magnified in species at higher trophic levels, including marine mammals. For example, dolphins feeding on deep scattering layer organisms are likely to eat fish and squid that have been in direct contact with the sediment plume.

42. There is also the possibility of direct effects on marine mammals. Sperm whales and beaked whales routinely dive to depths far greater than than 450 metres so it is certainly possible that they would encounter the sediment plume.

CUMULATIVE IMPACTS

43. There is considerable uncertainty as to whether the cumulative impacts of the proposed mining operation on any of the marine mammal species in the area are sustainable. This uncertainty applies to the cumulative impacts from mining itself (e.g. cumulative impacts of the combined effects of noise, sedimentation and ecosystem effects caused by mining) and the combination of mining impacts and other human impacts (e.g. fishing).

44. Insufficient information has been provided to assess cumulative impacts for any of the marine mammals using the Chatham Rise area. Much more information is required to determine whether the proposed mining would exceed tipping points for any of these species.

45. The development clearly involves potential risks, which are additional to existing threats (e.g. marine mammal mortality in fishing gear, pollution, aquaculture and vessel strike, several of which are expected to increase). On the basis of the available information, there is a high level of uncertainty as to whether the cumulative impact of this development added to existing threats would allow the endangered species of marine mammals in the area to recover to non-threatened status.

46. Marine resources are often managed such that new developments are declined only when harmful effects on other environmental or economic interests can be demonstrated (Thompson et al. 2000). This approach poses particular problems for the conservation of marine mammal populations, partly
because there are often several threats affecting the same species. It is often difficult to demonstrate the effects of individual threats and even more challenging to determine the total, cumulative impact of all human activities in the marine environment on a particular species. Added to that, even with the best techniques, the challenges inherent in studying marine mammals often result in estimates (of parameters like survival and population size) with relatively low levels of precision and low statistical power to detect environmental impacts (e.g. Taylor and Gerrodette 1993). Because marine mammals are long-lived, long-term studies are usually needed to estimate population parameters and to detect changes in those parameters. The difficulty of statistically detecting population change means that only relatively large changes can be detected. Populations can decline very markedly in this process, to the point that risk of extinction is substantially increased (Taylor et al. 2007). For example, a 50% decline in 15 years could not be detected for 90% of US beaked whale populations and for 72% of large whale populations (Taylor et al. 2007). In response, many countries are adopting precautionary management principles.

RESEARCH AND MONITORING

47. This section covers research:

47.1 To provide the DMC with data on which to base its decision on whether to grant resource consent

47.2 Requirements for baseline data which would make it possible to monitor impacts, if consent is granted (“Before” data)

47.3 Monitoring during mining, if consent is granted (i.e. conditions)

48. The joint statement includes a mitigation (exclusion) zone at 1.5 km from the mining operation in order to reduce the risk of physiological impacts on hearing such a temporary hearing impairment. Such a zone does not address behavioural responses, masking or other physiological impacts, such as stress responses. Visual and acoustic surveys would be conducted with the goal of detecting marine mammals within this area in order to stop mining or delay the start of mining. It is common for these kinds of conditions to be suggested for activities like marine mining and exploration (e.g. seismic surveys). However, the effectiveness of such measures has yet to be demonstrated (e.g. Wright 2014). Data on detection probabilities (from visual and acoustic surveys such as the methods proposed) are essential in order to determine the likely effectiveness of the proposed conditions.
49. A serious problem with the proposed conditions, is that the probability of detecting marine mammals using the methods proposed is very low. For example, Leaper (2014) showed that marine mammal observers on seismic survey vessels see a very small proportion of the marine mammals in the area (especially deep diving species like sperm whales and beaked whales).

50. Barlow and Gisiner (2006) used sighting probabilities from research surveys, carried out by expert observers, to provide a crude estimate of the likely effectiveness of marine mammal observers (MMOs) on seismic survey vessels: “A crude estimate of the detection probabilities for beaked whales for typical mitigation monitoring can be made by reducing the probability estimates for research surveys (0.23 to 0.45 respectively for Cuvier’s and Mesoplodon beaked whales, Barlow, 1999) by several independent factors to account for the differences in survey efficiency. These factors include a roughly two-fold reduction in efficiency because beaked whales cannot be seen at night, a two- to four-fold reduction to account for searches in rougher sea states (detection probabilities decrease by a factor of two for every increment in Beaufort sea state – Barlow et al., 2006), a three-fold reduction to account for the image size difference in 7X vs 25X binoculars and a two-fold reduction to account for the lower number of observers used in mitigation surveys. Therefore, the overall probability of detecting beaked whales is likely to be 24 to 48 times lower for mitigation monitoring than for research vessel surveys. Based on this, mitigation monitoring detects fewer than 2% of beaked whales if the animals are directly in the path of the ship. This approach does not include factors to account for training or experience in identifying beaked whales, but Barlow et al. (2006) showed that experience can account for a two-fold difference in the likelihood of detecting beaked whales. The probability of detecting a beaked whale with 7X binoculars drops to zero approximately 1km from a ship.” i.e. The probability of an MMO on a seismic survey vessel detecting a beaked whale directly on the transect line of the vessel is on the order of 1-2%. Unfortunately, beaked whales spend only on the order of 25% of the time vocalising. Therefore, even using a combination of visual observations and acoustic monitoring, the probability of detecting these species are very low.

51. Direct estimates of typical sighting and acoustical detection probability of MMOs following the DOC guidelines are essential in order to determine the effectiveness of the proposed conditions. Such estimates were not available to the marine mammal expert group.

52. The proposed conditions are at best a "feel good" measure. At worst, the proposed conditions give the impression that something is being done to manage and control impacts, when in reality the proposed mitigation measures are highly ineffective. Marine mammal observers have a particularly low sighting probability in poor visibility conditions such as high wind speed, rough seas, fog or at
night (Leaper 2014; Weilgart 2014). Passive acoustic monitoring is also dependent on the marine mammals vocalizing, being heard, localized, and correctly identified to species, as well as sea state, which affects ambient noise conditions.

53. Even if all individuals were detected within a safety zone, only a very small proportion of the marine mammals in the area would be detected, as the vast majority affected are likely to be far beyond the 1.5 km “safety zone”. These animals may also be experiencing impacts such as temporary threshold shifts, physiological stress, in addition to or as a result of behavioural disruption. In addition, shutdowns may occur for the more visible species but noise will also impact the less visible species.

54. It is difficult to determine if marine mammals would avoid the area (e.g. when mining in actually taking place, or over longer time periods), moving away to areas where no such activity is taking place. BACI (Before, After, Control, Impact) research of marine mammal use of the area would be needed to establish that. Scientifically robust surveys would be required for any such investigation. Photographic identification of individuals could also be carried out during boat surveys to help determine if particular species or individuals of some species are more sensitive to the mining impacts.

55. It would be very difficult to detect effects on survival, reproduction, feeding success and population size of marine mammals, certainly without baseline estimates of these biological parameters. These data are critical in terms of the conservation management of marine mammals, and would take a decade or more to collect.

56. It is important in evaluating research and monitoring programmes to consider statistical power, i.e. to ensure that sufficient data are collected to be able to detect meaningful environmental effects. In the case of endangered species, even very small effects can be biologically meaningful. Therefore, sample sizes and the duration of the study would need to be much larger to be able to detect biologically meaningful effects.

57. Determining the biological effects of individual behavioural responses on the population requires accurate estimates of survival, reproduction and population size. Therefore, determining population level impacts would take a much longer period of research than studies of behavioural responses (e.g. determining whether dolphins avoid the area during and/or after mining). Changes in population size, survival and reproduction quantify the actual impact of human activities on the population. These are therefore the key parameters to measure. The length of time and intensity of research effort required to estimate these parameters makes “adaptive management” impractical for marine mammals.
Relatively short periods of data collection on marine mammal populations before mining (e.g. 1-3 years), would result in a monitoring programme with little if any chance of detecting impacts on marine mammals. From a scientific point of view, three years of baseline monitoring is the minimum required to collect baseline data on distribution and abundance of marine mammals and this is also the minimum to provide a realistic chance of detecting effects on other species. These baseline data can then be used to carry out a “power analysis”, to estimate the sampling intensity and duration needed to detect biologically meaningful effects.
References:


Popper, A. Evidence for CRP on impacts of noise on fish.


